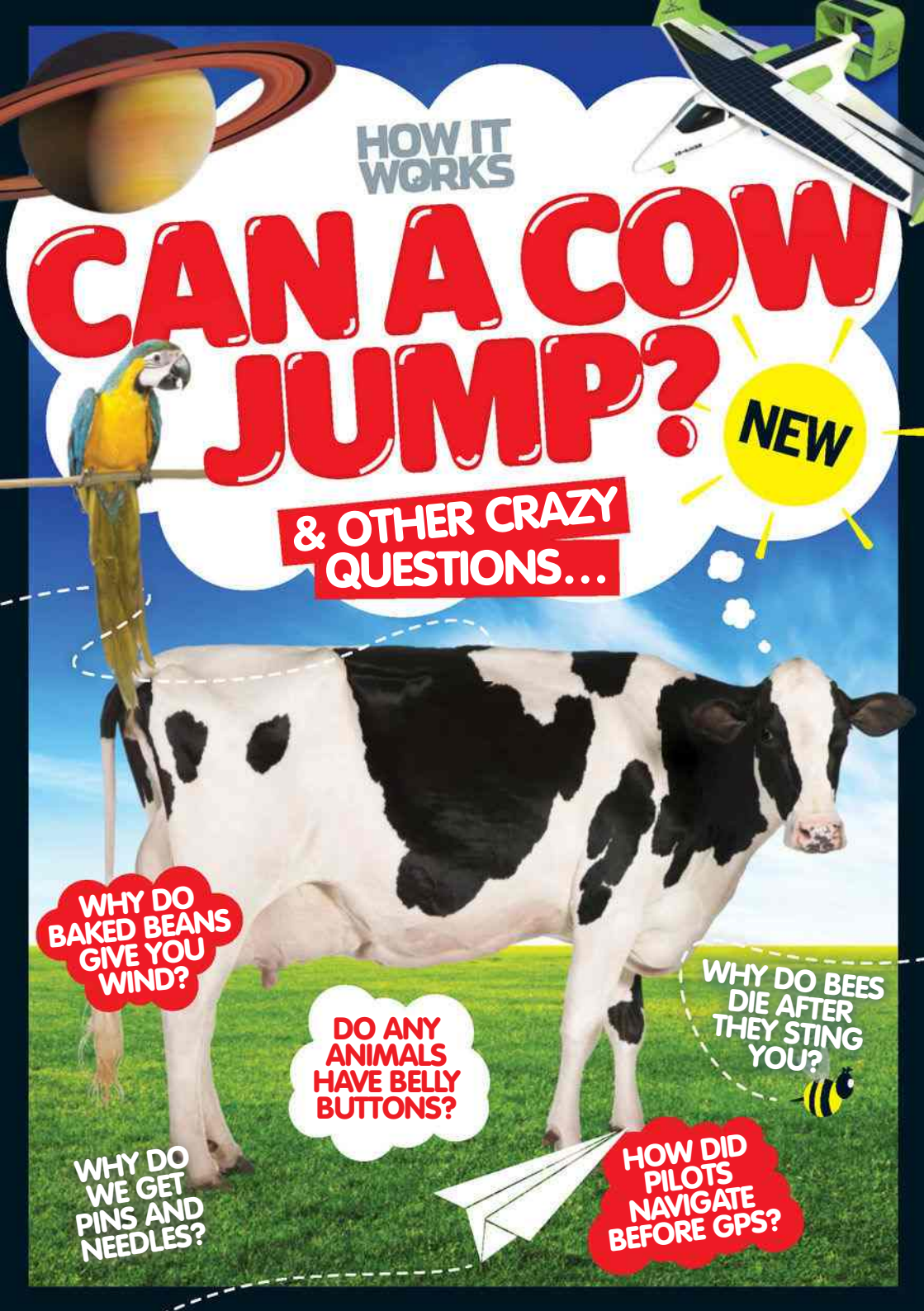
HOW IT WORKS
CAN A COW JUMP?
NEW
& OTHER CRAZY QUESTIONS...
WHY DO BAKED BEANS GIVE YOU WIND?
DO ANY ANIMALS HAVE BELLY BUTTONS?
WHY DO BEES DIE AFTER THEY STING YOU?
WHY DO WE GET PINS AND NEEDLES?
HOW DID PILOTS NAVIGATE BEFORE GPS?

Welcome to

HOW IT WORKS

CAN A COW JUMP?

& OTHER CRAZY QUESTIONS...

How much does the sky weigh? How do fish sleep? Why do boomerangs come back? These are just a few of the questions asked and answered in Can a Cow Jump? In this bookazine we'll investigate some of the craziest questions around, diving into the science behind each and providing you with enough fascinating trivia and knowledge to last a lifetime. So, can a cow jump? Read on to find out!

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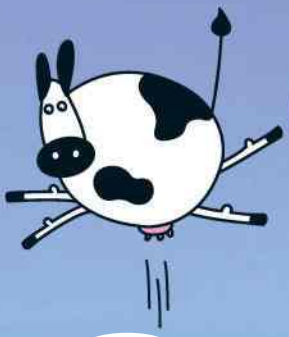
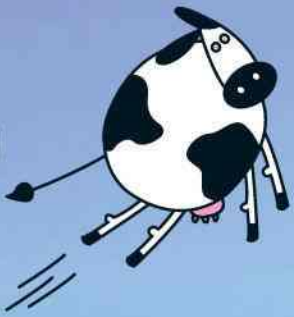


CAN A COW JUMP?

& OTHER CRAZY QUESTIONS...



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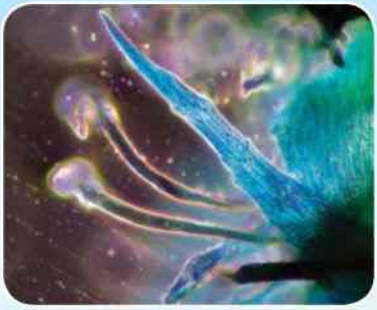

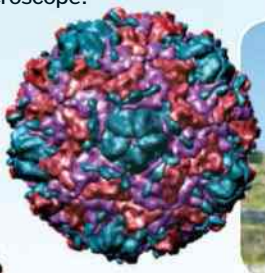

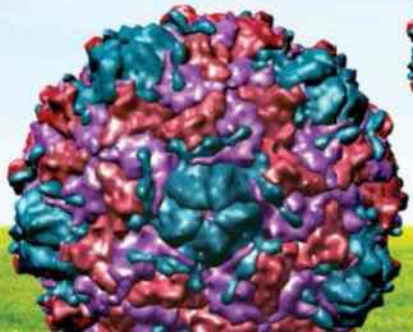

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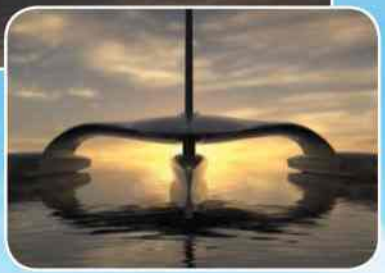

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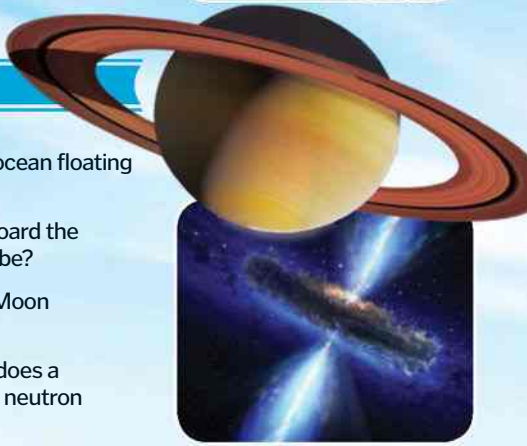


How old is your body?

Like all living organisms, our bodies are made up of cells – humans are built from trillions of them – and over time, many of them become old and worn and need to be replaced. To keep up with this constant wear and tear, our bodies produce millions of new cells every single second. The speed at which this process happens varies massively depending on the cell type, however, and can be studied using techniques which 'mark' each cell's DNA. When a cell divides, each of the two daughter cells receives half of the marked DNA, allowing researchers to track how often each cell type is replaced. This process ranges from occurring on a weekly basis in some parts of the body, to happening just a handful of times during an entire lifetime in others.

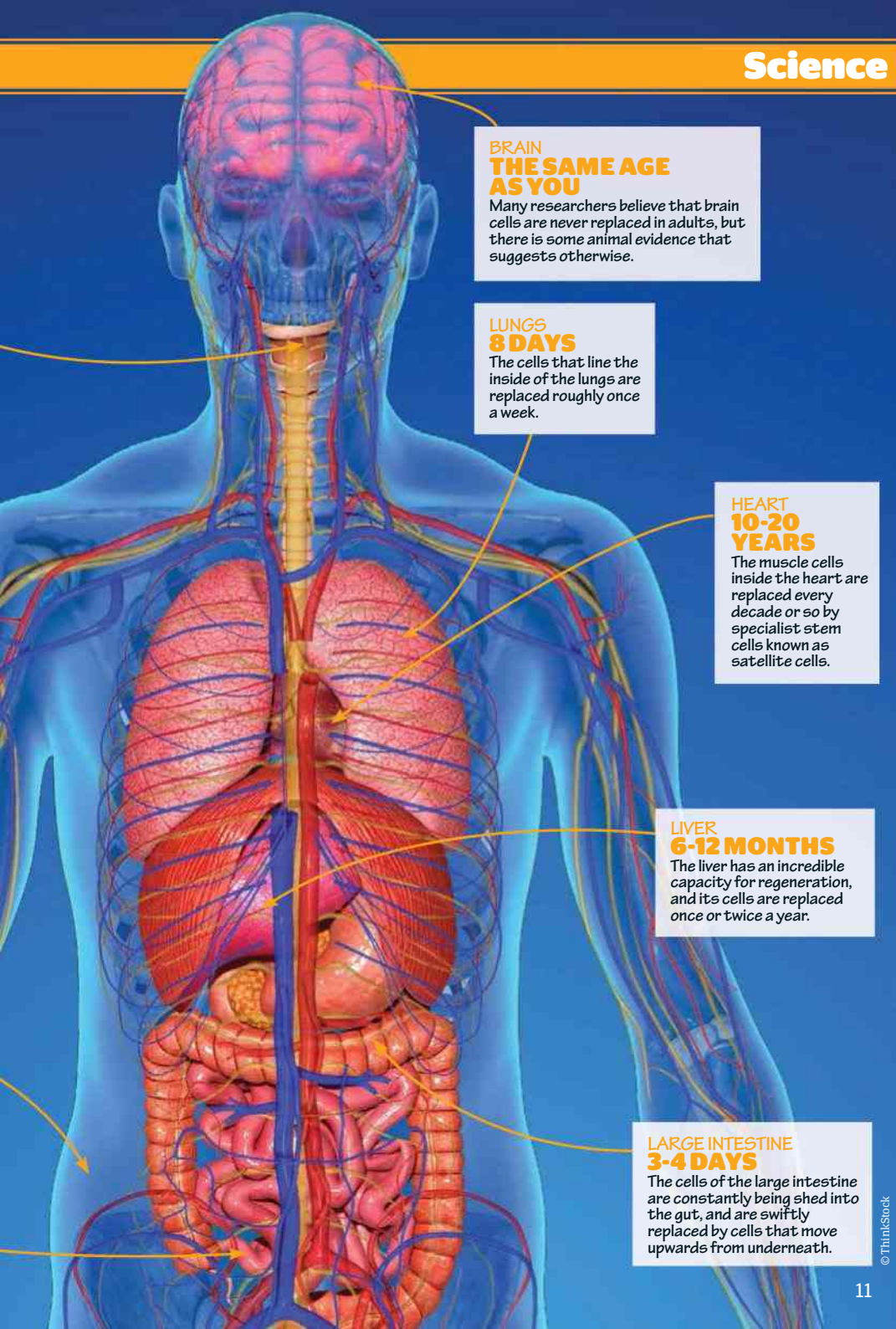
TRACHEA
1-2 MONTHS
The cells that line the windpipe are replaced less frequently than the cells inside the lungs, around once a month.

WHITE BLOOD CELLS
1-5 DAYS
Neutrophils are the immune system's front line soldiers. Stem cells in the bone marrow ensure that they are replaced every few days.

RED BLOOD CELLS
120 DAYS
After a few months, these cells become old and stiff. They are removed by the spleen and replaced by the bone marrow.

FAT
8 YEARS
The number of fat cells in the body does not change much, even when we gain or lose weight.

SMALL INTESTINE
2-4 DAYS
The lining of the small intestine gets a lot of wear, and the cells are constantly being replaced.



BRAIN
THE SAME AGE AS YOU
Many researchers believe that brain cells are never replaced in adults, but there is some animal evidence that suggests otherwise.

LUNGS
8 DAYS
The cells that line the inside of the lungs are replaced roughly once a week.

HEART
10-20 YEARS
The muscle cells inside the heart are replaced every decade or so by specialist stem cells known as satellite cells.

LIVER
6-12 MONTHS
The liver has an incredible capacity for regeneration, and its cells are replaced once or twice a year.

LARGE INTESTINE
3-4 DAYS
The cells of the large intestine are constantly being shed into the gut, and are swiftly replaced by cells that move upwards from underneath.

What does hunger do to your body?

The feeling is all too familiar: a growling in the pit of your stomach that usually starts around late morning when breakfast is just a memory and lunchtime is still a tiny speck on the horizon. It's hunger – a feeling that begins with the hormone known as ghrelin. Once your body has finished digesting and using up the energy from your last meal, your blood sugar and insulin levels drop. In response to this, ghrelin is produced in the gut and travels to the brain, letting it know that sustenance is needed. The brain then commands the release of a second hormone called neuropeptide Y, which stimulates appetite.

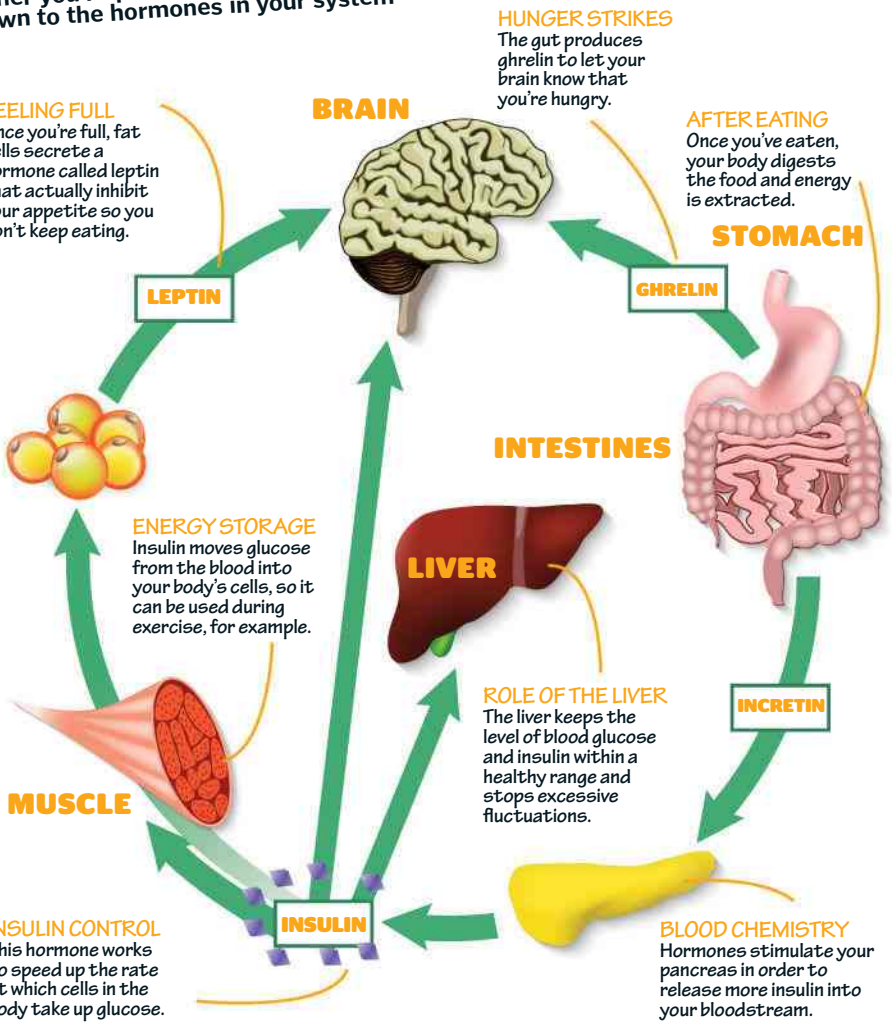
Once you have answered the call and filled up on a good meal, your stomach gets to work on digestion. Nerves in your stomach sense stretching that lets your brain know you're full up. Three other hormones also secreted by your digestive system take messages to the brain: cholecystokinin (CCK), GLP-1 and PYY. CCK helps to improve digestion by slowing down the rate at which food is emptied from the stomach into the small intestine, as well as stimulating the production of molecules that help to break down food. GLP-1 tells the pancreas to release more insulin and also reduces appetite. The hormone PYY is secreted into the bloodstream by the small intestine after eating. It binds to receptors in the brain to make you feel full up.

Once all of the food is digested, the blood sugar and insulin levels drop and ghrelin is produced once more, so the hunger cycle continues.

The stress hormone, cortisol, can increase appetite and cause a person to overeat

HUNGRY HORMONES

Whether you're peckish or ravenous, it's all down to the hormones in your system



WHEN THE MIND TAKES OVER...

When our bodies tell us we are hungry, it's an innate reaction – the hormones in our systems let us know we need sustenance. But when our minds get involved, it's a whole different story.

There's not much nutritional value in a bacon sandwich or a doughnut, for example, so it's not a 'need' for a treat, it's a 'want'. This is because the first time you experienced a doughnut, the mesolimbic centre of your brain (the region that processes pleasure) lit up, as the fatty, sugary goodness of the treat released chemicals known as opioids that bind with receptors in the brain.

This triggers the release of dopamine, the hormone that makes us happy. Your brain remembers this response, and encourages you to repeat the pleasurable feeling by eating more.

Why do baked beans give you wind?

Baked beans are a tasty treat that are high in fibre and therefore good for your digestive system. However, as they make their way through your body, they also produce an unfortunate side effect: flatulence. This bodily function is a result of sugars called oligosaccharides that are contained within the beans. These sugar molecules are too big to be absorbed in our small intestines, and our bodies do not produce the enzyme that can break them down, so they carry on through to the large intestines intact and undigested. Here, they're met by our gut bacteria, which have no problem breaking them down into something more manageable. As they do this, they produce gasses including hydrogen and methane, which gradually accumulate in your lower intestine and escape through your rectum as flatulence.

However, if you want to avoid having to blame the noise (and smell) on the dog, then there are some gas-relieving supplements that you can take. These typically contain the enzyme alpha-galactosidase, which is capable of breaking down the sugars in the small intestine, before those pesky gas-producing bacteria can get to them.

Baked beans contain sugars that our bodies struggle to digest

Odour sprays need to have their own strong scent to overcome their odour neutralising properties

What do odour sprays actually do?

Products such as odour sprays have often been criticised by scientists for their wrongful claims of destroying smells, when they actually only mask them with a stronger scent. However, modern odour sprays do have some real chemistry behind them, and are perfect for those of us looking for a quick fix to a whiffy problem.

Sprays such as Febreze contain a chemical called cyclodextrin. These molecules have a cage-like structure that means they can trap other molecules within them. Cyclodextrin forms a ring with a hydrophobic (water repelling) centre, enabling it to attract other hydrophobic molecules, such as the molecules causing the unpleasant smell.

At this stage, the bad smelling molecule is still there but is unable to bind to the scent receptors in your nose, so you can't actually smell it. Rather than just being covered by another smell, which is how cheap, masking odour sprays work, the molecules have been effectively neutralised. As an odour spray dries, scented molecules bind to the cyclodextrin at a faster rate, lowering the concentration present in the air and eliminating the odour permanently.

What causes pins and needles?

Pins and needles is a type of 'paraesthesia' – a word which comes from the Latin for 'abnormal sensation'. It tends to happen when the blood supply to a nerve is temporarily reduced, like when you sit with your legs crossed for too long, or when a nerve is squashed.

Nerve cells are constantly pinging signals around the body, and each time they pass a signal on they need to reset before the next one comes. When nerve cells are starved of blood they cannot reset properly, so they just fire when they can, sending irregular messages onwards towards the brain. The disruption also affects the nerve cells waiting for their signals further down the line, which can start to fire off without warning.

The reason it feels like pins and needles is that the first nerve fibres to stop working are the smallest ones – the ones responsible for pain.

When nerve cells start to run out of energy, they can misfire

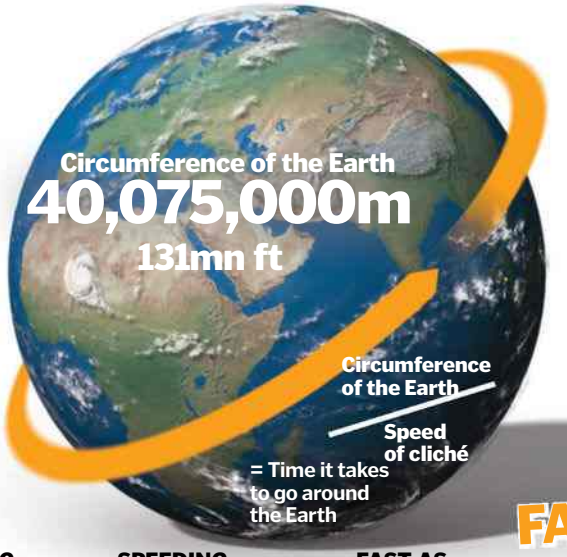
Which cliché is the fastest?

BLINK OF AN EYE
0.03m/s
0.1ft/s
42 years

DROP OF A HAT
5.7m/s
20.5ft/s
81 days

LIKE WILDFIRE
6.3m/s
20.5ft/s
73.6 days

ONE FELL SWOOP
107m/s
352ft/s
4.3 days



SUPERSONIC SPEED
344m/s
328,084ft/s
32.4 hours

SPEEDING BULLET
1,200m/s
3,937ft/s
9.3 hours

FAST AS LIGHTNING
100,000m/s
328,084ft/s
6.7 mins

FASTEST!
SPEED OF LIGHT
299,792,458m/s
328,084ft/s
0.134 secs

Two-way mirrors are often used in police interrogation rooms

How do you make a two-way mirror?

Mirrors are traditionally composed of a piece of glass covering a layer of metal (usually aluminium). When light passes through the glass and hits the metal then it's reflected, which is why you see yourself. A two-way mirror contains less of this metal coating. For example, if just half the mirror's total surface area is covered by reflective molecules then the two-way mirror reflects only half of the light that hits it, with the remaining light passing through to the other side. As long as the room on the other side is darkened, it is possible to see through the mirror into the brighter room.

You can check if you're facing a two-way mirror by placing your fingernail against the reflective surface. If there is no gap between your nail and the reflected image then beware, you could be being watched.

Why do I gag when someone is sick?

This phenomenon is also known as sympathy vomiting. Scans of the brain have actually shown that when you see someone vomiting, your brain has the same activity as if you're the one vomiting. You're feeling the same disgust that they are. Scientists think that this could be the source of empathy, and may also be an evolutionary tool. If someone in your family clan ate food that had gone bad, it's likely that you would have eaten it too. If it caused them to vomit, it would be better for you – from an evolutionary standpoint – to also vomit and get rid of any toxins. Unfortunately, this seems to be hard-wired into our brains.

Why are habits so hard to break?

Some habits are extremely beneficial; the ones that you go through as part of your morning routine before work are a good example of this. Other habits activate the pleasure centres in our brains, triggering the release of a feel-good chemical called dopamine. It doesn't distinguish whether the habit itself is good for us, and repeating habits that release dopamine ultimately changes the way our brains work. That's why addiction has come to be classified as a disorder or a disease, rather than a flaw in a person's character. Knowing that the habit isn't good for you doesn't keep your brain from wanting you to keep it up.

SHOOTING AN ARROW

Consistently hitting targets is all down to the hormones in your system

How do you fire the perfect arrow?

Made famous by the likes of Robin Hood and more recently Katniss Everdeen, archery is both a worldwide sport and an ancient hunting technique, developed during the late Stone Age. Whether it's a traditional long bow or a more modern recurve bow, the physics behind firing an arrow is much the same.

The bow essentially acts as a two-armed spring. As the arrow is pulled back on the drawstring, the bow works to convert the force into potential energy. The force applied by the archer, known as the draw weight, bends the bow's limbs and adds elastic potential energy, ready to transfer to the arrow when the drawstring is released.

Hooke's Law states that the draw weight is proportional to how much you deform the bow's limbs (how far you draw the string back), something known as the draw length.

When archers become more experienced, they are able to draw their arrow to an identical point (usually in line with their cheek, temple or ear) each time. This helps them to fire every arrow at the same speed, which improves their accuracy and ensures that they consistently hit the target.

Archers learn to bring the drawstring up to the same place, for consistent shots

Is there any scientific truth behind the five-second rule?

This is something that is still debated, but scientists have done some interesting experiments testing food left on various contaminated surfaces for different amounts of time. However, some of the research has not been peer reviewed (checked by other experts), so it is hard to draw firm conclusions. In general, the findings from these different experiments showed that bacteria start transferring onto food almost as soon as it hits the floor, and their numbers increase over time. If the food hits a smooth bacteria-coated surface, like wood or laminate, it can become unsafe to eat very quickly, but if it hits carpet, the bacteria transfer much more slowly.

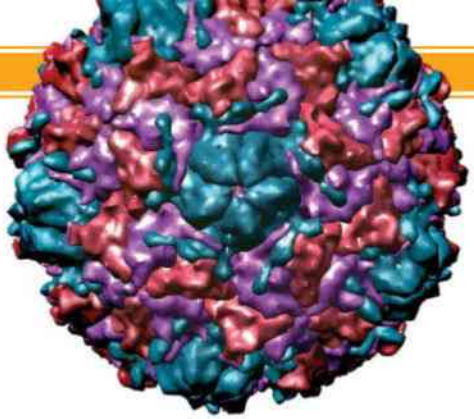
Dreams are generally forgotten unless you wake during or straight after them

Why do we have trouble remembering our dreams?

Research using positron emission tomography (PET) to measure brain activity has found that people who tend to remember their dreams in the morning have more activity in an area of the brain that processes external stimuli. These people are more likely to respond to sounds while they sleep and spend longer periods awake in between dreams. In general, you will only remember a dream if you wake up during or immediately after it finishes. And even if you do wake in the middle of the night, many dreams fade by the morning because they are too jumbled to make an easily remembered sequence.

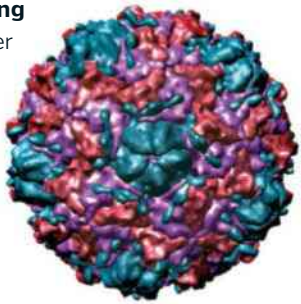
Is dark chocolate better for you than milk chocolate?

Dark chocolate is better for you than milk chocolate, as it generally contains more of the good stuff and less of the bad stuff. In other words, it has healthy monounsaturated fatty acids, less sugar, more fibre and therefore fewer carbohydrates. It also has much more iron and magnesium, more phosphorus and potassium, less sodium and less cholesterol. It even contains theobromine, which helps lower blood pressure. In addition to this, cocoa found in dark chocolate is rich in antioxidants. It reduces inflammation, which is great for the cardiovascular system and lowers the chances of cardiovascular disease. Plus, bioactive compounds can improve blood flow to the skin and even protect the skin from Sun damage.



Why can't we cure the common cold?

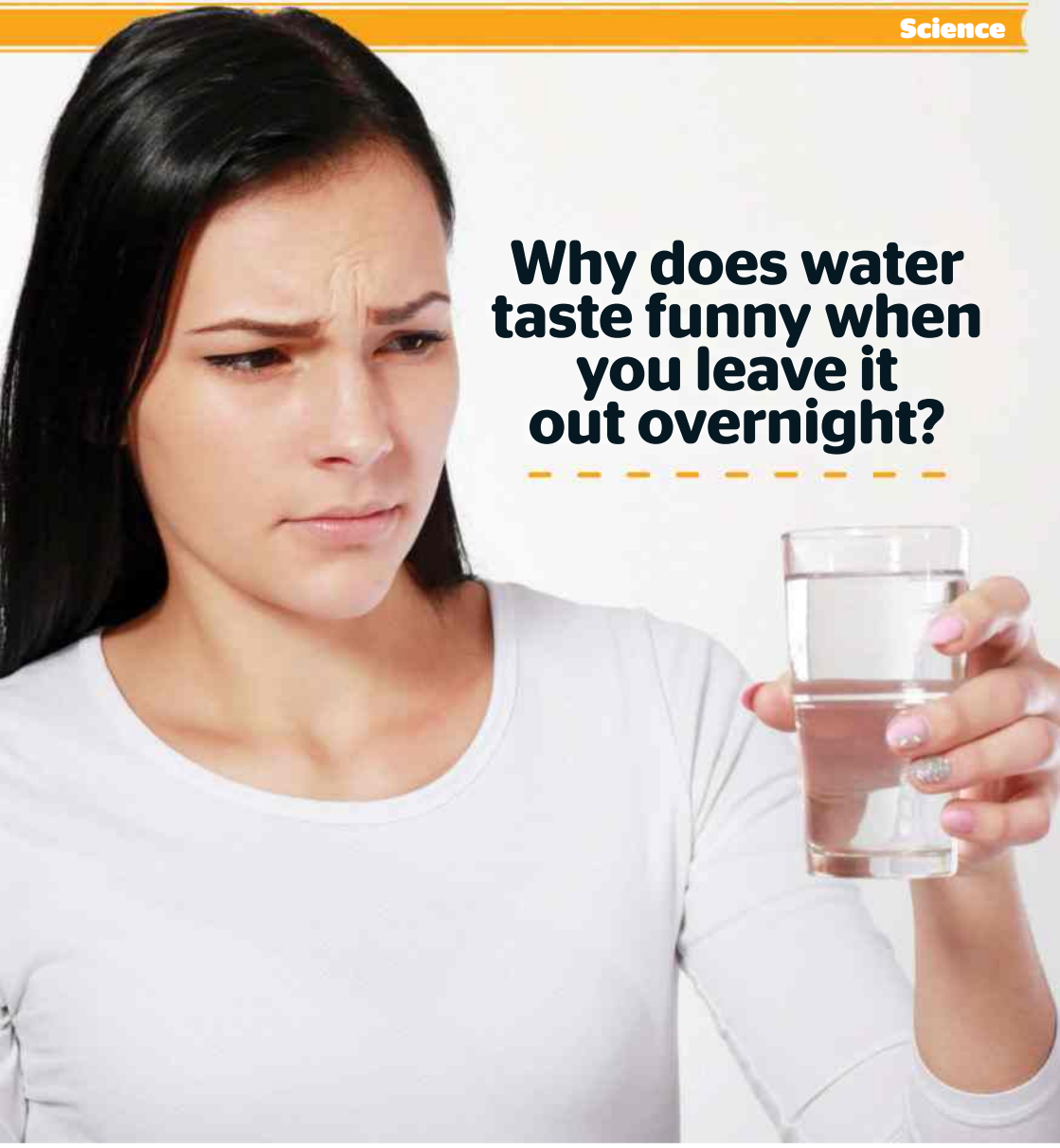
The common cold is caused by a number of viruses, making it hard to tackle the infection with a vaccination or cure. Over half the cases of common colds are thought to be caused by rhinoviruses, but there are more than 100 unique variants of these, and they are constantly adapting and evolving. Attempting to create a cure would be entering a biological arms race that we would be extremely unlikely to win – by the time we came up with a good drug, the cold-causing viruses would have mutated. Preventing the common cold from spreading is far easier than trying to eliminate it.



Can you get sunburnt through glass?

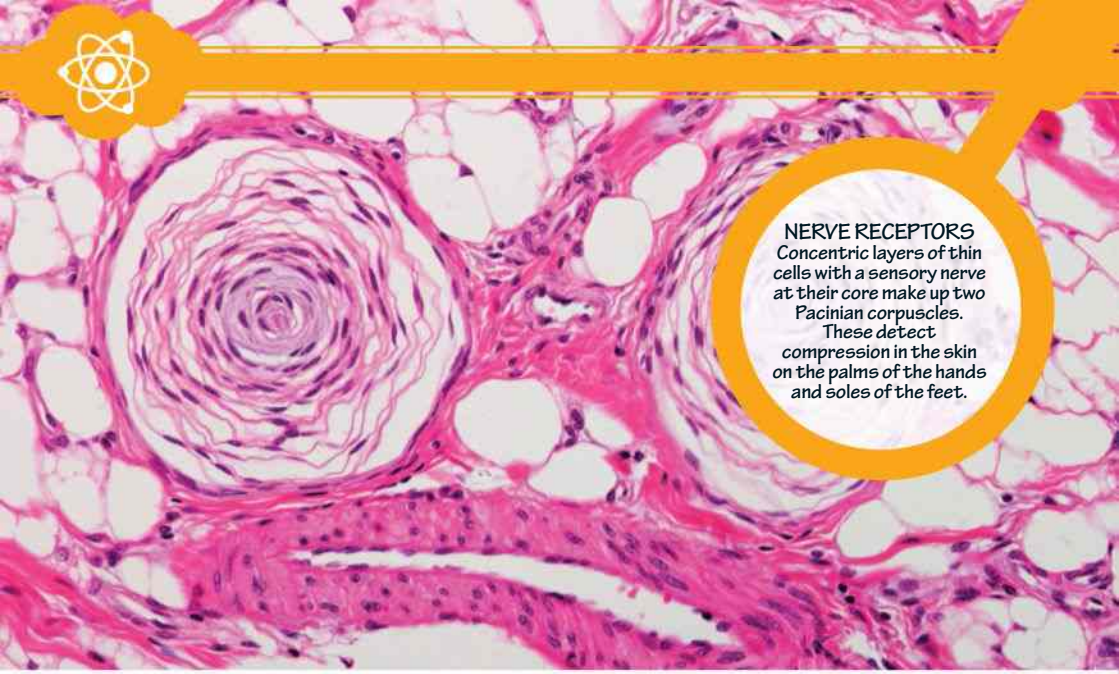
The glass used for windows typically filters out 97 per cent of the UVB rays, which can cause sunburn and skin cancer, so it's unlikely you would get burnt unless you were exposed for a longtime. However, glass is far less effective at blocking UVA radiation, eliminating just 37 per cent. UVA light causes skin to age more rapidly and may also contribute to some types of skin cancer, so it's still wise to apply sunscreen. Car windscreens typically contain a plastic layer that filters out all UVB radiation and 80 per cent of UVA.

Why does water taste funny when you leave it out overnight?



According to water chemist Susan Richardson no proper studies have ever been conducted to answer this question. However, there are lots of possible explanations. In the UK and US, chlorine is added to drinking water to keep the public water system clean.

As it comes out of the tap, it still contains traces of the chemical, but left overnight, some of the chlorine will evaporate, changing the taste. Carbon dioxide dissolving in water makes it more acidic, and other chemical contaminants from the air could also affect the flavour.



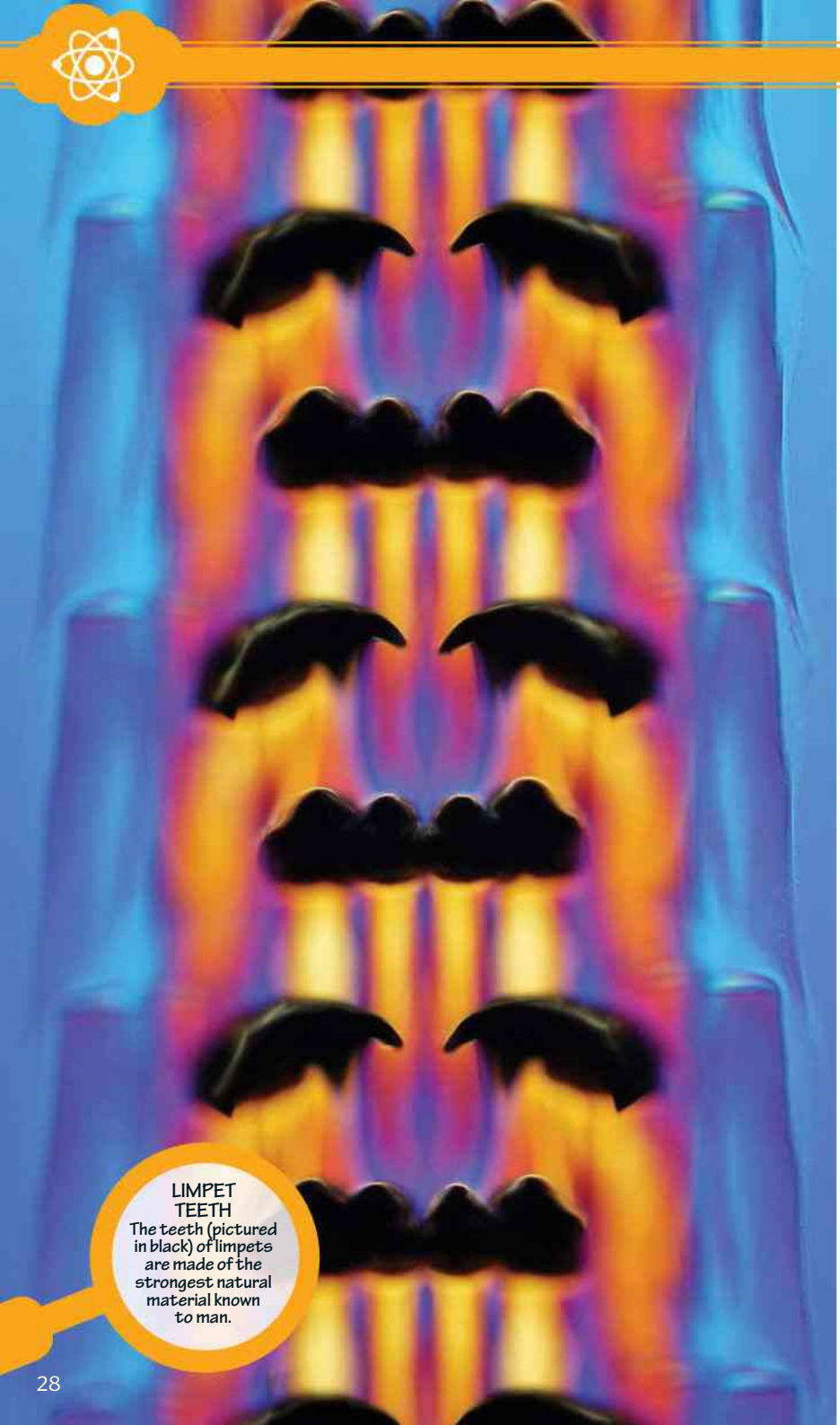
NERVE RECEPTORS
Concentric layers of thin cells with a sensory nerve at their core make up two Pacinian corpuscles. These detect compression in the skin on the palms of the hands and soles of the feet.

What goes on under a microscope?

Taking a closer look at even the most ordinary of objects can reveal beauty you never knew was there. To help expose some of these breathtaking secrets, the Royal Photographic Society challenged the general public to photograph whatever they could get their hands on, all in the name of science. Their 2015 International Images For Science competition received submissions from scientists, students and even young schoolchildren, showcasing stunning photography of sub-atomic particles, distant galaxies and everything in between. Here is a just a small selection of the amazing entries.

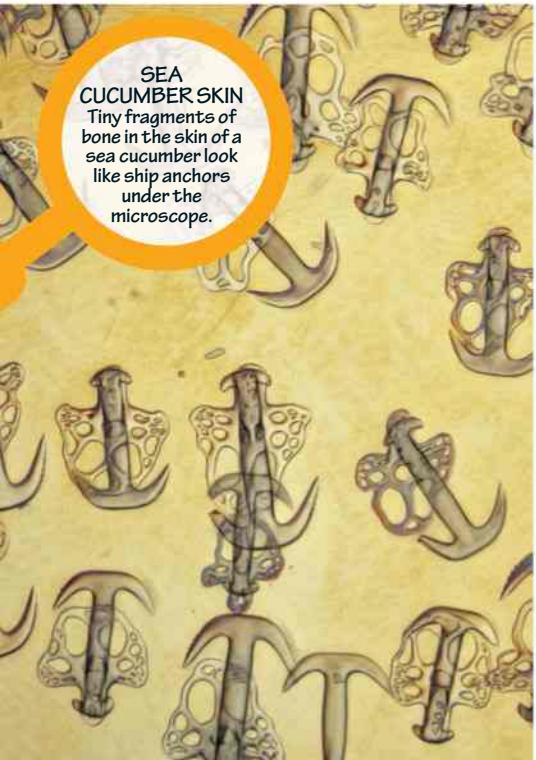
CATERPILLAR WINDPIPE

Invertebrates, such as this silk moth caterpillar, do not have lungs. Instead, air is diffused through a tree-like network of tubes in their tracheal system, delivering oxygen to every cell in their bodies.

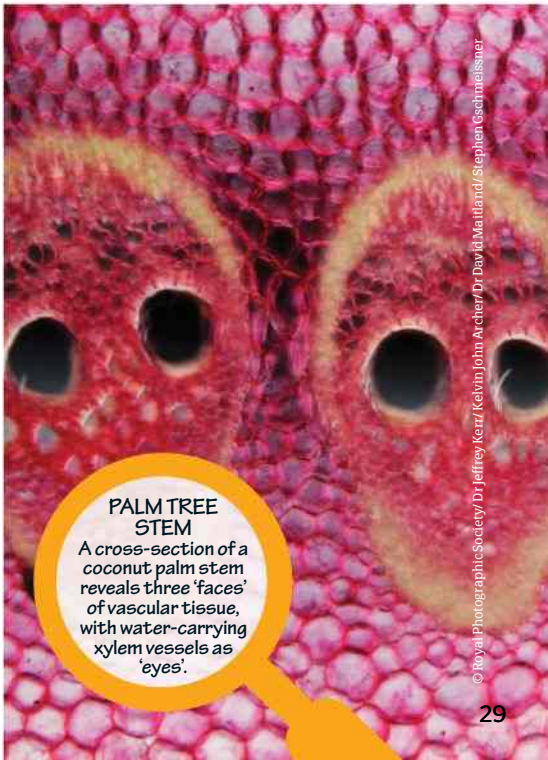


LIMPET TEETH
The teeth (pictured in black) of limpets are made of the strongest natural material known to man.

LEMONGRASS
By dying it blue, the intricate detail of lemongrass is revealed at 100x magnification.



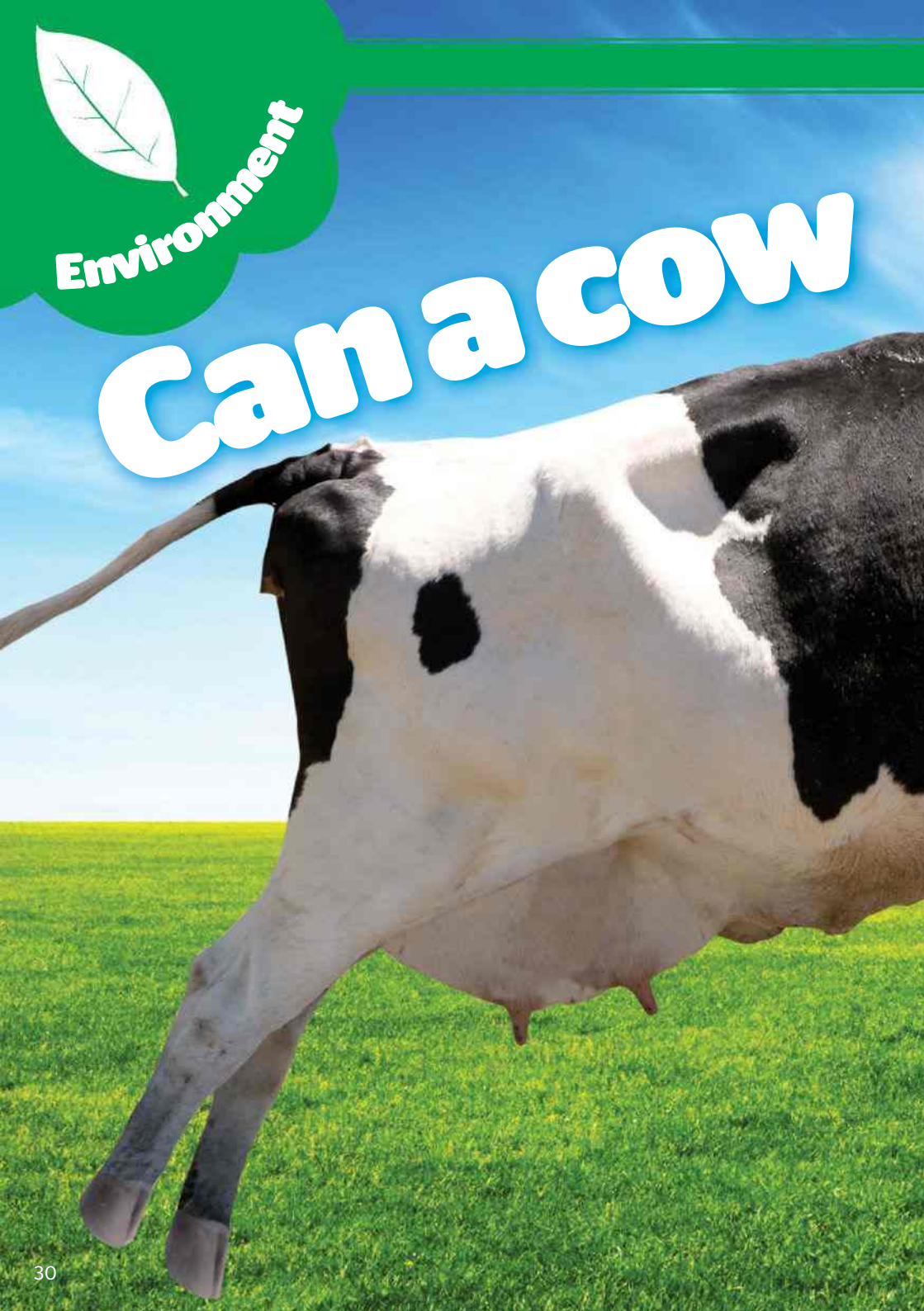
SEA CUCUMBER SKIN
Tiny fragments of bone in the skin of a sea cucumber look like ship anchors under the microscope.



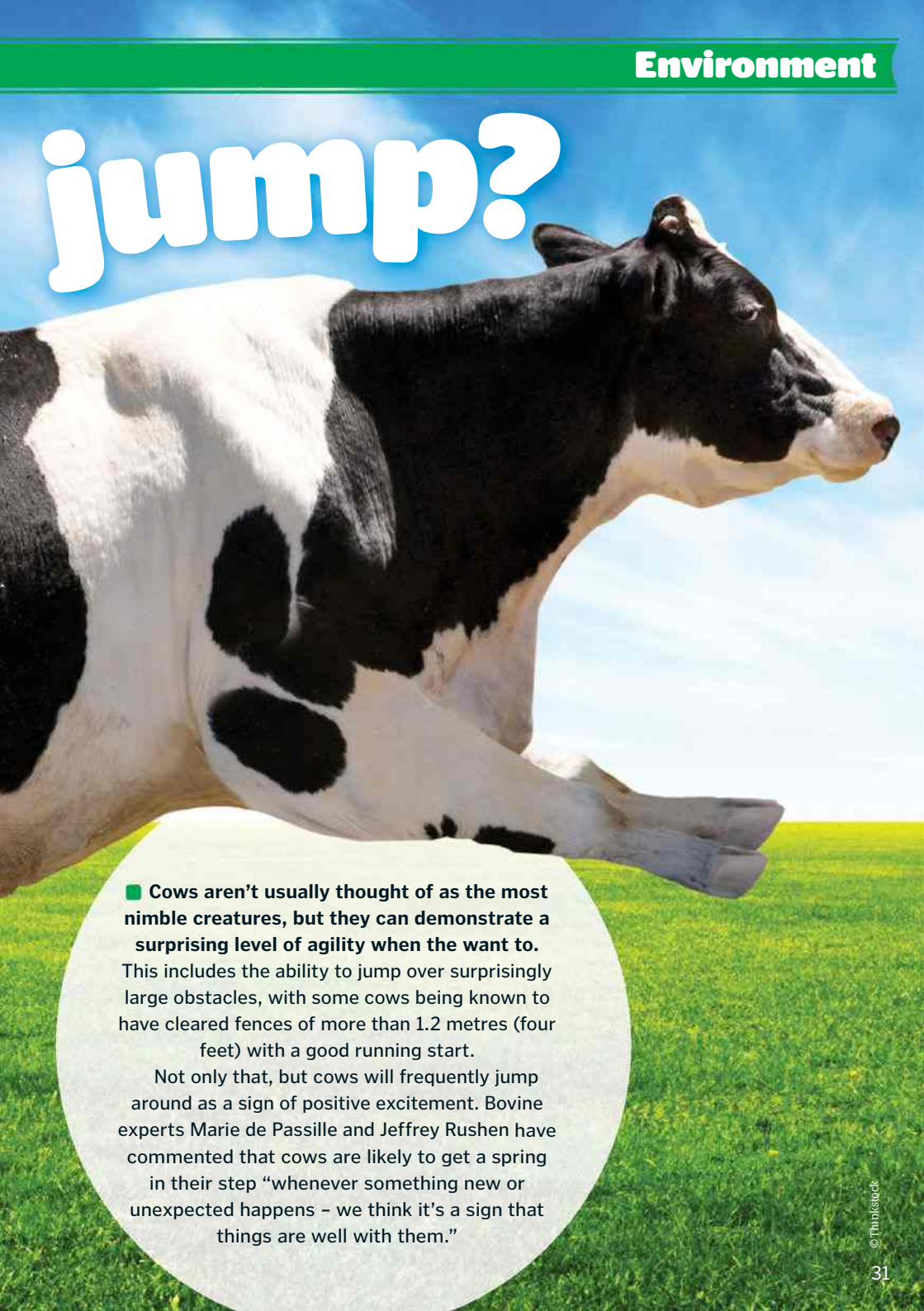
PALM TREE STEM
A cross-section of a coconut palm stem reveals three 'faces' of vascular tissue, with water-carrying xylem vessels as 'eyes'.

Environment

Can a cow



jump?



Cows aren't usually thought of as the most nimble creatures, but they can demonstrate a surprising level of agility when the want to. This includes the ability to jump over surprisingly large obstacles, with some cows being known to have cleared fences of more than 1.2 metres (four feet) with a good running start.

Not only that, but cows will frequently jump around as a sign of positive excitement. Bovine experts Marie de Passille and Jeffrey Rushen have commented that cows are likely to get a spring in their step "whenever something new or unexpected happens – we think it's a sign that things are well with them."

Although usually measuring around 10cm (3.9in), some oysters can reach over 30cm (11.8in) or more

Can oysters really be both male and female?

Oysters are amazing bivalve molluscs – sea creatures related to slugs and snails that live in hard, hinged shells. Considered a culinary delicacy and aphrodisiac in many countries around the world, oysters live naturally in large colonies, called beds or reefs, throughout the world's oceans, as well as being farmed commercially. They feed by filtering plankton from the water column, and are considered to be 'ocean cleaners' due to their ability to filter many gallons of water over their gills every day. Capable of living for up to 20 years, these salt-water critters also have an incredible life cycle.

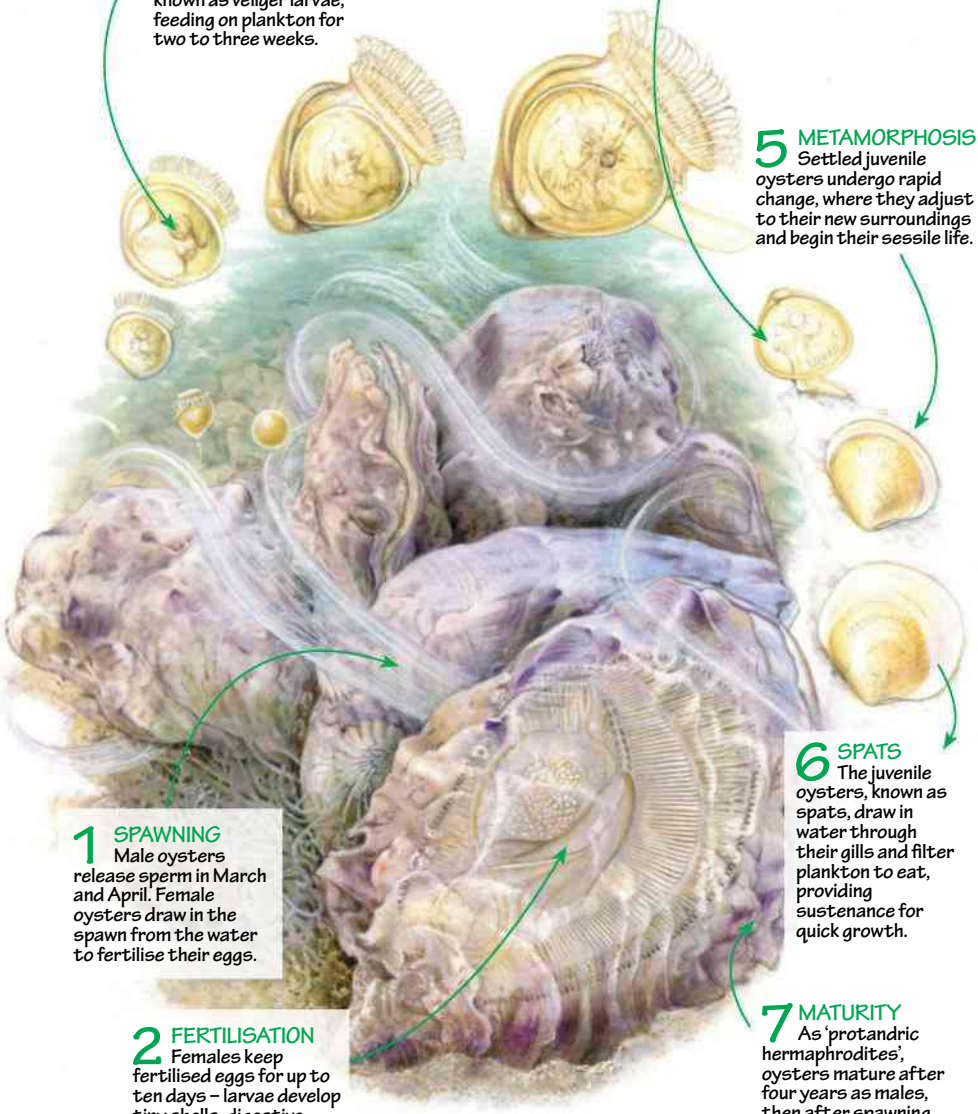
Oysters take cues from their environment in order to gauge precisely the right time at which to spawn, but it usually takes place in the spring. When the temperature is at an optimum value (this varies depending on the oyster's specific location), the male oysters release sperm into the water, and the female oysters draw it in. Once their eggs have been fertilised, they then release them into the water column to begin their journey.

The fertilised eggs grow as free-swimming larvae until it's time for them to settle. They then seek out a hard substrate to attach to, keeping them anchored as they mature.

One of the surprising things about oysters is that they are able to spawn as both male and female. All oysters settle and begin adult life as male, then after spawning once they switch sexes and develop as females to spawn again, this time with eggs rather than sperm. This phenomenon can happen twice in one season!

FROM EGG TO SHELL

The stages of life as a European oyster



1 SPAWNING
Male oysters release sperm in March and April. Female oysters draw in the spawn from the water to fertilise their eggs.

2 FERTILISATION
Females keep fertilised eggs for up to ten days – larvae develop tiny shells, digestive systems and swimming and feeding organs.

3 LARVAE
When released into the water column they're known as veliger larvae, feeding on plankton for two to three weeks.

4 SETTLERS
After feeding, larvae sink to the seabed to settle and undergo cementation, where they anchor firmly to a rock.

5 METAMORPHOSIS
Settled juvenile oysters undergo rapid change, where they adjust to their new surroundings and begin their sessile life.

6 SPATS
The juvenile oysters, known as spats, draw in water through their gills and filter plankton to eat, providing sustenance for quick growth.

7 MATURITY
As 'protandric hermaphrodites', oysters mature after four years as males, then after spawning they become female and produce eggs.

Why does this lake smell like rotten eggs?

If a ticket to Mars is a little out of your price range, then a visit to Dallol in Ethiopia might be the next best thing. The colourful landscape looks as though it belongs on another planet, with green pools of acid, strange salt formations and toxic gases spewing from the surface.

The area is actually a large volcanic crater, formed when rising basaltic magma made contact with salt deposits and ground water. This caused the water to evaporate immediately, resulting in a huge eruption of rock, ash, water and steam. The Dallol crater was formed during an eruption in 1926, but the area is still alive with geothermal activity today. Hot springs spurt out a briny substance, created as hot water dissolves salt and other soluble minerals beneath the surface. As the brine evaporates in the hot climate, it creates salt formations that are coloured white, yellow, orange, green and brown by sulphur, iron oxide and other chemical compounds. The sulphur is emitted as gas from cracks in the ground, making the shallow green pools on the surface highly acidic, and the surrounding area smell of rotten eggs.

That's not the only thing that might put you off visiting though, as Dallol is also one of the hottest places on Earth. The average annual temperature is 35 degrees Celsius (95 degrees Fahrenheit), but frequently exceeds 45 degrees Celsius (113 degrees Fahrenheit) in the summer months. It's no wonder this harsh desert has been labelled the 'Hellhole of Creation'.

"It looks as though it belongs on another planet, with green pools of acid and toxic gases spewing from the surface"

+ *Dallol's dramatic landscape features colourful acidic pools and salt deposits*

How can one tree create a whole forest?

Vast forests of pine trees can be found in many different regions, from the snowy mountains of North America to the open plains of Europe. These hardy evergreen trees can grow in environments that many others can't, favouring acidic or sandy soils and rocky regions at high altitudes.

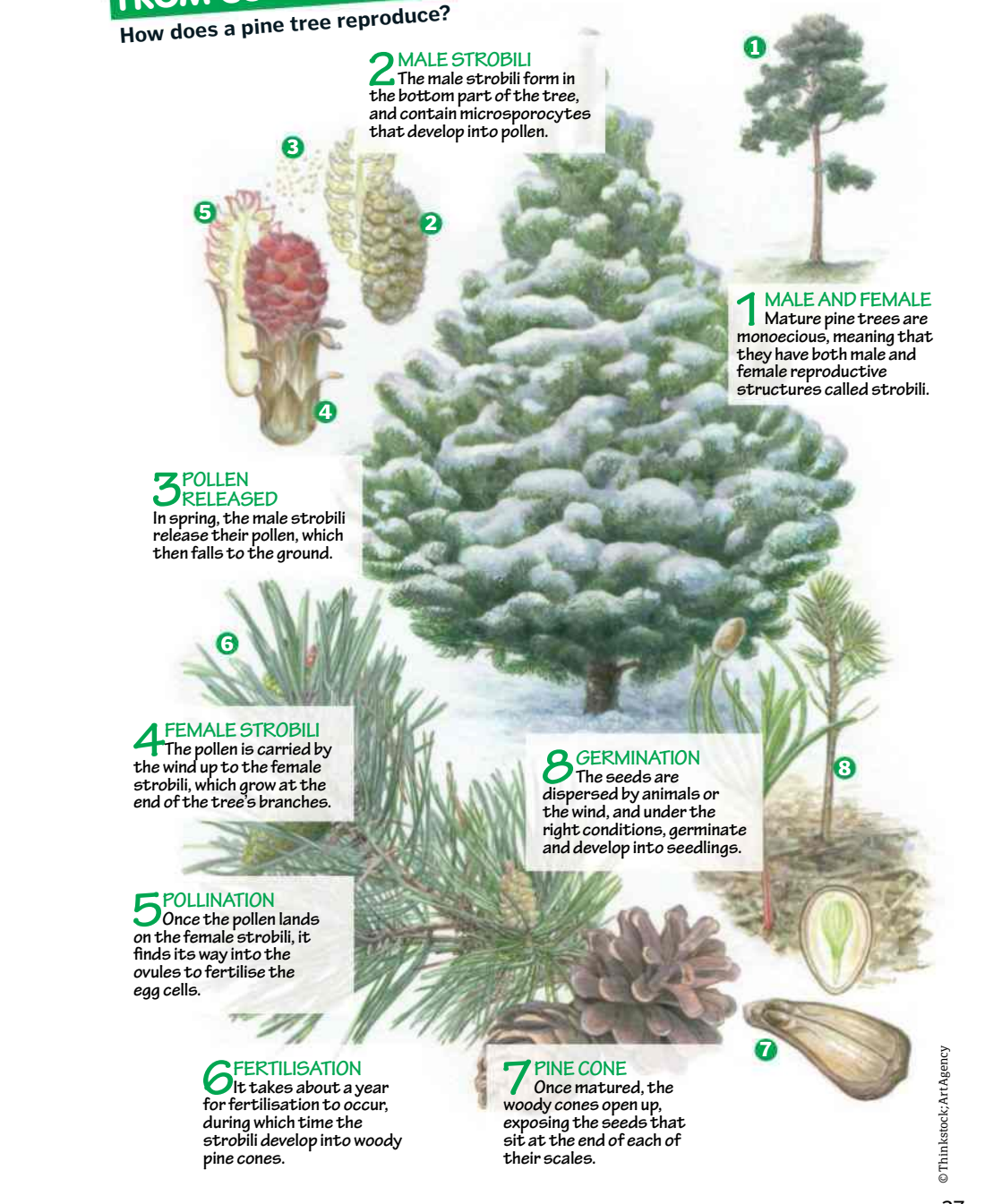
When exposed to plenty of sunlight, pines can grow up to a towering 80 metres (262 feet) and live for hundreds of years. One bristlecone pine in California is thought to be 5,000 years old, making it one of the oldest trees in the world, but most are cut down long before they reach this ripe old age.

Although pines are native to temperate regions in the Northern Hemisphere, some species have been introduced to southern continents as a valuable source of timber, an industry worth billions of pounds. The young pines that don't go on to become fence panels and furniture usually end up as Christmas trees in homes across the world. Over 77 million pines are planted for this purpose each year, and take six to eight years to reach optimum Christmas tree size. However, when left to their own devices, pine trees grow to have long, slender trunks – almost unrecognisable as the same trees we decorate with tinsel and fairy lights – and use pine cones to reproduce. Each tree uses both male and female structures to create the next generation.

"When exposed to plenty of sunlight, pines can grow up to a towering 80 metres (262 feet)"

FROM CONE TO TREE

How does a pine tree reproduce?



1 MALE AND FEMALE
Mature pine trees are monoecious, meaning that they have both male and female reproductive structures called strobili.

2 MALE STROBILI
The male strobili form in the bottom part of the tree, and contain microsporocytes that develop into pollen.

3 POLLEN RELEASED
In spring, the male strobili release their pollen, which then falls to the ground.

4 FEMALE STROBILI
The pollen is carried by the wind up to the female strobili, which grow at the end of the tree's branches.

5 POLLINATION
Once the pollen lands on the female strobili, it finds its way into the ovules to fertilise the egg cells.

6 FERTILISATION
It takes about a year for fertilisation to occur, during which time the strobili develop into woody pine cones.

7 PINE CONE
Once matured, the woody cones open up, exposing the seeds that sit at the end of each of their scales.

8 GERMINATION
The seeds are dispersed by animals or the wind, and under the right conditions, germinate and develop into seedlings.

The devastation caused by La Niña in Queensland was unprecedented; thousands of homes were destroyed

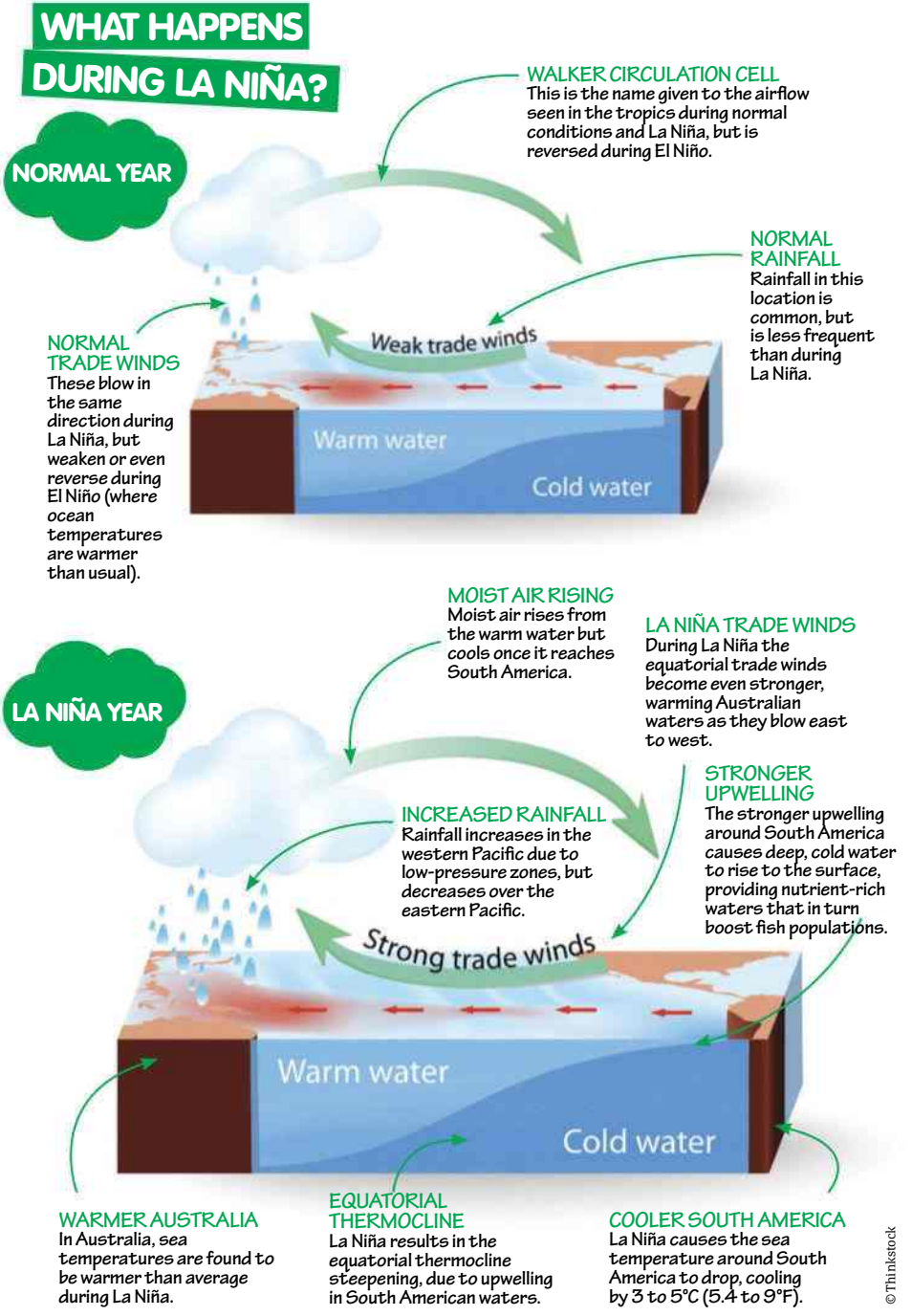
What on Earth is La Niña?

La Niña is a Pacific Ocean phenomenon that is defined by unusually cold ocean temperatures. It's caused by a build-up of cool water in the tropical Pacific, which is brought to the surface by easterly trade winds and ocean currents. This upsurge of water causes sea-surface temperatures in areas near South America to drop drastically and very rapidly.

La Niña can trigger significant changes in rainfall patterns, atmospheric circulation and atmospheric pressure, all of which have dramatic effects on the global climate. La Niña events are associated with cataclysmic flooding in Northern Australia. In 2010, they resulted in arguably the worst flooding in Queensland's history, causing more than two billion Australian dollars' worth of damage and requiring the evacuation of over 10,000 people. La Niña does have some positive effects, however, often boosting the South American fishing industry due to the upwelling of nutrient-rich waters, where fish populations thrive.

Although our understanding of La Niña has grown, forecasting it is still difficult, even when combining the latest satellite and marine buoy data. With such a global impact, every effort is being made to find a way to predict this age-old phenomenon.

WHAT HAPPENS DURING LA NIÑA?



DROSERA

There are over 100 species of drosera, which are commonly known as 'sundews' as they appear to be constantly covered in dew. However, these tiny droplets are actually sticky enzymes that trap and start to digest prey as soon as it lands on the plants' leaves.

PINGUICULA

This plant catches prey using sticky leaves. The tacky substance is actually full of digestive enzymes, which break down the insects once they become trapped. When winter arrives, some species of pinguicula become quite dormant and cease their carnivorous activities.

NEPENTHES

These plants lure insects, and sometimes even rats, into their cup-like pitchers with an attractive scent. Once trapped, the prey drowns in the liquid within the pitcher and is broken down by digestive juices, allowing the plant to absorb the vital nutrients it needs to survive.

What are the world's deadliest plants?

SARRACENIA

Like Nepenthes, sarracenia is a pitcher plant. Insects are attracted to its colour and sweet scent. As they land at the edge of the pitcher, they often fall in, since the edge is very slippery. Once inside, there is no escape due to the smooth, steep sides of the pitcher.

VENUS FLYTRAP

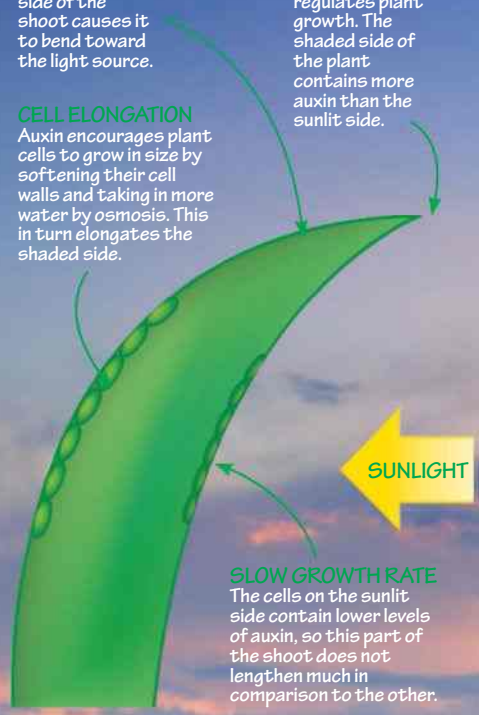
When an insect or arachnid steps on more than one of the tiny hairs of the plant's jaws, it triggers a violent reaction. The hinged mouth snaps down, trapping the prey inside the plant. Digestive enzymes are secreted and it can be several days until the plant re-opens.

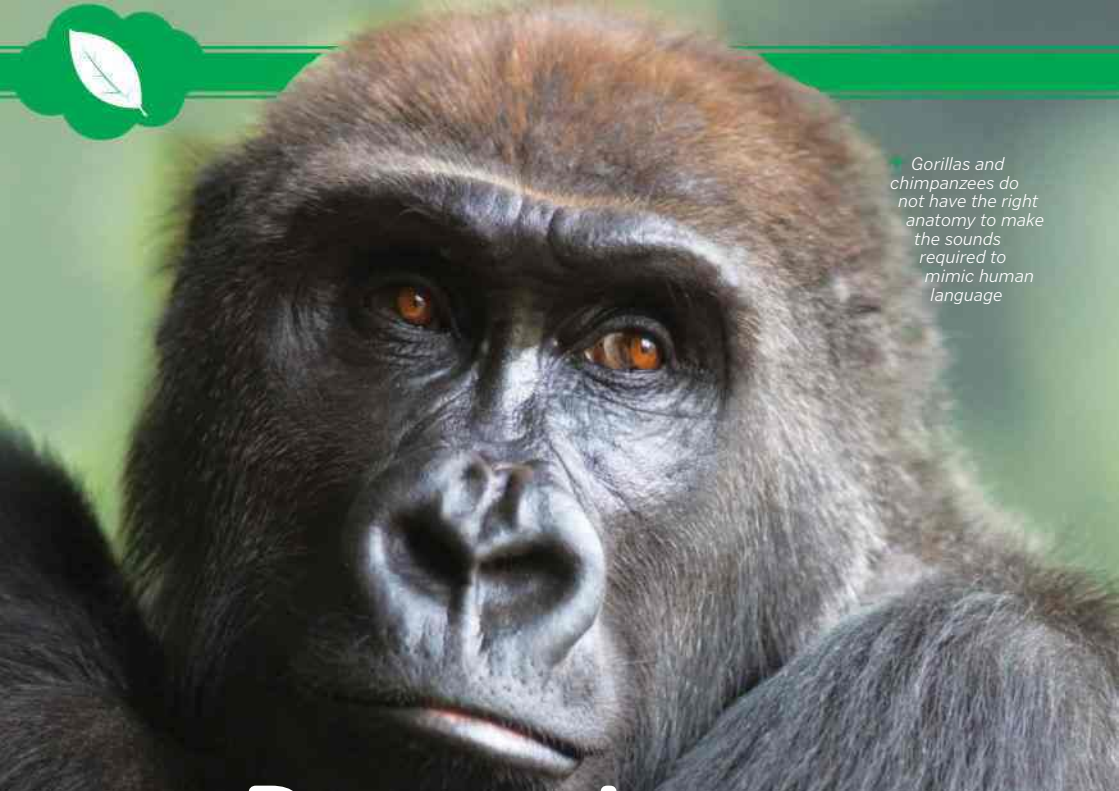
How do plants grow towards light?

Plant cells contain a protein called phototropin, which is activated when it absorbs the blue wavelength of light during photosynthesis. This leads to an uneven distribution of the hormone auxin (which regulates growth) in the stem. The exact mechanisms behind this process are not fully understood, but one theory is that auxin molecules are able to move from cell to cell, away from the area where light was detected. Auxin causes cells to enlarge, so the shaded side of the stem, which contains more of the hormone, elongates, forcing the plant to bend towards the light as a result.

Sunflowers take their quest for sunlight to the extreme. They follow the sun throughout the day, physically rotating their leaves and flowers to make the most of the available light. At night they then unwind, returning to their starting position ready for sunrise. No one knows why the flowers follow the Sun as well as the leaves, but it's thought the extra heat may help to grow more seeds.

PHOTOTROPISM





Gorillas and chimpanzees do not have the right anatomy to make the sounds required to mimic human language

Do apes have the ability to talk like humans?

We share a number of characteristics with our closest living relatives, but verbal language is not one of them. This is partly due to anatomical changes that began over 100,000 years ago.

Humans have smaller mouths than other great apes, with flexible tongues, elongated necks and fine control over breathing. In concert, these adaptations allow us to make a much greater variety of sounds than chimpanzees or gorillas, and together these different noises make up the core of spoken language.

However, just because apes lack the anatomy to speak, doesn't mean they are incapable of language. Chimpanzees have learnt to communicate with humans via sign language, and bonobos can associate images with words using specially designed computers.

But whether they truly understand or are just after rewards is up for debate. While some chimps have memorised a lot of words, they don't seem to be able to combine them to form sentences or to describe complex ideas.

How can parrots talk?

It's important to note that parrots don't actually 'talk'; they're simply mimicking our speech. However, they're one of a very small group of animals capable of learning sounds and repeating them. Scientists had long thought that this might be due to the size of the parrots' brains, but it's also to do with their structure. Along with hummingbirds and songbirds, parrots have vocal learning centre in their brains called 'cores'. Unlike other birds with song-mimicking abilities, however, parrots also have a surrounding shell. This shell is larger in parrots that are especially known for their ability to learn and repeat human speech.

These green parrots have larger and more complex brain structures

Do any animals have belly buttons?

Belly buttons are few and far between in the animal kingdom, but the majority of mammals have them. Since placental mammals are all gestated inside their mothers, they are born with their umbilical cords still attached. Once delivered, their mothers typically chew through the cord, which tends to leave a flat scar or small bump that is much less visible than a human's belly button, with the animal's hair often obscuring their navel even further. There are mammals that prove an exception to this rule. Platypuses lay eggs, so there is no umbilical cord, while marsupials do have umbilical cords but these usually become detached when inside their mother's pouch. As they are still very small at this stage, a scar never develops into a visible navel.

There's no real evidence that breathing in sea air is good for you

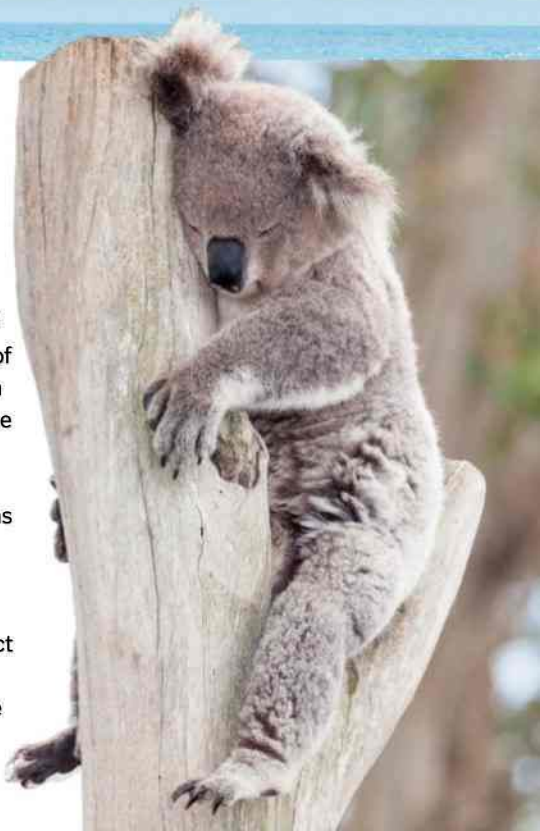
Is sea air really good for you?

Sea air has long been thought to be a cure for many ills. Victorians visited seaside resorts to take in the supposedly restorative air, but it may just have been a respite from the sooty cities. Whether sea air actually is good for you is a matter of debate. Some believe that the moist air full of salt, iodine, and other minerals stimulates the immune system and can clear the lungs of those with respiratory illnesses. There's some anecdotal evidence that patients with cystic fibrosis can breathe better after spending time at the ocean, but there's no statistical evidence to support it yet. In some cases at least, healthy people report feeling better because they're relaxing, feeling lulled by the sound of the waves, and getting more exercise.

Why do koalas sleep so much?

Koalas need 18-22 hours of sleep per day. This isn't because the little critters are lazy; their diet of eucalyptus leaves requires them to conserve a lot of energy. It's a common misconception that the oil in eucalyptus leaves 'drugs' them, and the sleepy state is a result of being drunk. However, koalas need to sleep in order to digest and break down their food, which is tough, fibrous, low in nutrition and contains toxins which take a long time to digest.

Koalas eat between 200 and 500 grams (7.1 to 17.6 ounces) of eucalyptus per day. Their specially developed digestive system enables them to extract nutrients and detoxify chemicals in the normally poisonous leaves. They also extract water from the leaves, which is why koalas don't drink much.



How do birds avoid electrocution?

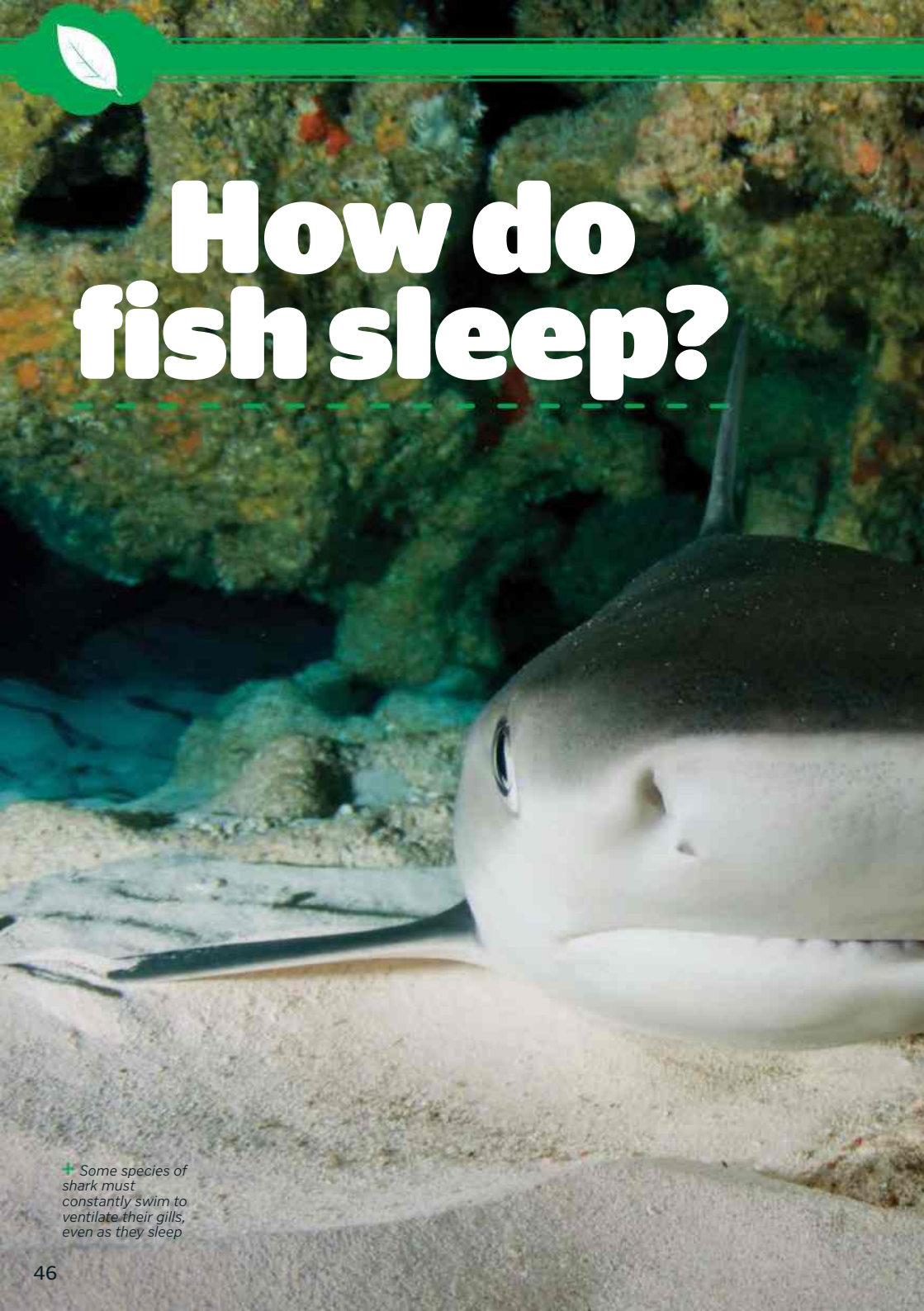
Birds normally only sit on a single wire, so they act like a resistor in parallel with the wire. Electricity can either flow through the wire, or up one leg, through the bird and down the other leg. As the bird is a much worse conductor than the wire, almost all of the electrical current flows through the wire. However, birds do experience a brief static shock when they land on a wire, because their body acts like a capacitor that gets charged up. But a bird is a very weak capacitor and the shock amounts to less than half a milliamp.

How much does the sky weigh?

A rough estimate of the entire weight of the atmosphere, as experienced at the Earth's surface, would be a whopping 5 million billion tons. The 'sky' is made up of all the molecules in the atmosphere, which press down on you from above and in all directions to create what is known as air pressure. On average, this column of air weighs 1.05 kilograms per square centimetre (15 pounds per square inch). Simply multiply this figure by the Earth's total surface area (510 million square kilometres or 197 million square miles) and you can deduce the total mass of our planet's atmosphere with a reasonable degree of accuracy.

The sky's weight comes from the entire volume of air stretching into the upper atmosphere

How do fish sleep?



Some species of shark must constantly swim to ventilate their gills, even as they sleep

Many have questioned whether fish do even sleep, because they don't have eyelids and therefore can't close their eyes or experience rapid eye movement (REM). However, scientists have now studied behavioural patterns that suggest fish do sleep, but look more like they are daydreaming. Fish don't lie down, but tend to settle towards the bottom of their watery habitats. Some even need to keep moving while they doze to ensure constant ventilation of their gills. The amount of shuteye a fish gets depends on how active it has been, as well as various environmental factors. Interestingly, they can also suffer from sleep disorders and deprivation. So although fish sleep in a different way to us, there are some similarities.

The clouds move as fast as the wind blows them

How fast do clouds move?

Clouds on Earth move as fast as the wind is blowing them. The stronger the wind, the faster a cloud moves. On our planet, clouds can be found at different altitudes and move in different directions and speeds.

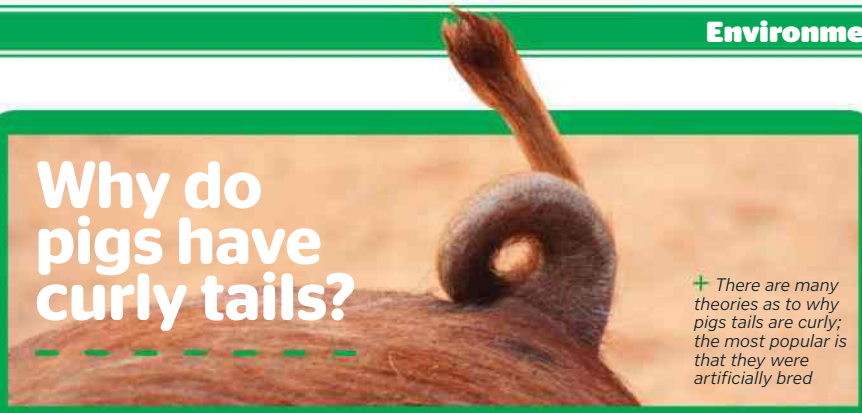
Wind speeds in the atmosphere vary with altitude, so the major factor in a cloud's movement is its height above the ground. In general, the higher up in the atmosphere you go, the faster the winds and therefore, the faster the clouds are being pushed along. High-altitude clouds in the jetstream, for example, can reach speeds of over 322 kilometres (200 miles) per hour.

Why do bees die after they sting you?

A worker honeybee protects the hive, even if it means sacrificing itself

Bad news for picnic fans, bumblebees and wasps can survive multiple stings – it's only the worker honeybees that die after administering a sting. The reason for this is due to the design of the stinger itself – shaped like a harpoon, the honeybee's stinger lodges itself into the target and is so effective that the bee cannot pull free. When it tries to get away, the bee self-amputates the stinger and with it removes part of its digestive tract, as well as some nerves and muscles. Unfortunately, the bee cannot survive this trauma and dies as a result.

Why do pigs have curly tails?



There are many theories as to why pigs tails are curly; the most popular is that they were artificially bred

Only domesticated pigs have curly tails – wild pigs actually have straight tails. There are a number of theories on why this might be the case, the most unexciting being that there is no real reason. The degree of curliness varies in that some domesticated pigs have a slight kink, while others have more of a curl. Another theory suggests that the curly tail evolved to protect pigs when fighting, as a curlier tail is harder to grasp. However, a more widely held belief is that the curled tail was artificially bred by Chinese farmers as they felt it was more aesthetically pleasing. This seems likely, given that the domestication of pigs occurred in China 8,000 years ago.

What's the difference between venomous and poisonous?

©Thinkstock

Both venomous and poisonous organisms can be harmful, sometimes deadly, but the difference between them lies in the delivery of their toxins. A venomous organism injects its venom into other organisms using either a stinger or fangs, which are attached to a gland that produces the venom. The venom is injected often to immobilise prey or protect against potential predators. It is therefore usually always intentional. Poisonous organisms are different in the sense that large parts of them, or often the entire organism, contain toxins. Therefore eating, or even just touching it, can prove harmful.

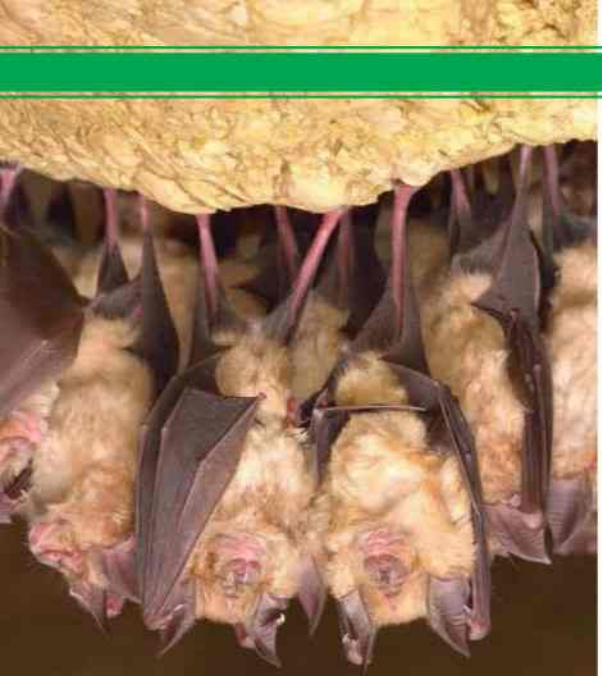
The common housefly can hide in the trickiest of spots, like on your ceiling

How do flies walk upside down?

What appears to be a smooth surface, like a ceiling, for example, is actually covered in tiny cracks and bumps too tiny to be seen by the naked eye. These can provide insects like flies with a sort of toehold, or rather, a hairhold. A fly's legs end in clawed segments called tarsi, which have pulvilli, or large footpads, at the bottom. The pulvilli are covered in lots of setae, stiff bristle-like hairs. The setae produce a glue-like goo that lets the fly adhere easily to smooth surfaces, but also enables them to quickly take off.

Are cats smarter than dogs?

A recent study found that the ratio of brain size to body size in dogs has been increasing for thousands of years. This may be because dogs are social animals, and the brain capacity required for social interactions means that these species are nearly always more intelligent than solitary ones, like cats. However, cats have almost twice as many neurons as dogs in their cerebral cortex – the region associated with learning and intelligence. Studies have shown that cats are just as good at solving puzzles, but it's hard to test because they are far less motivated.



Why do bats tend to live in caves?

Caves provide bats with a shelter where they can sleep or hibernate with minimal disturbance. Hanging from high ceilings and walls, bats are beyond the reach of most predators but also able to immediately launch into flight if needed. Large caves provide space for whole colonies to roost side-by-side, conserving energy. Caves' stable temperature and humidity conditions are also ideal for hibernation. Bats typically change roosts throughout the year to match their needs when foraging, raising offspring or hibernating. Not all bats live in caves, though; many species roost in trees and others have adapted to living in barns, houses, tunnels and bridges.

What makes birds fly into windows?

Unfortunately about half of the birds that collide with windows die, either from injuries caused by the collision itself or by another animal when the bird is stunned and unable to fly away. Ornithologists believe that the birds, which are usually small songbirds, are probably seeing the reflection of trees and open sky in the window, and think that they have a clear flight path. Your local ornithological society can give you tips on how to make your windows bird-safe and what to do if you find a stunned bird that has flown into a window.

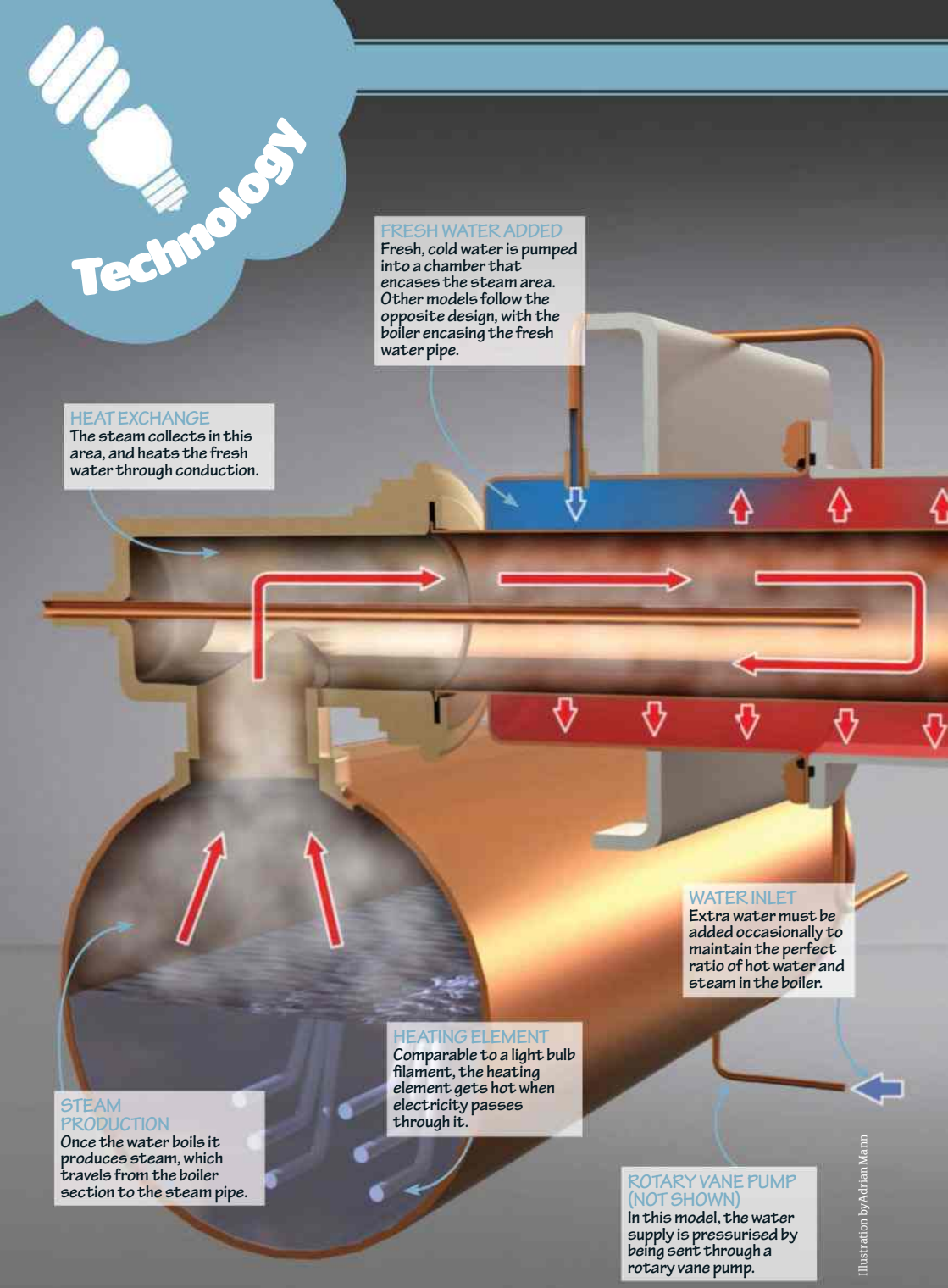


Illustration by Adrian Mann

How does an espresso machine brew your coffee?

Brewing the perfect espresso demands an ideal balance of grind, temperature and pressure. In order to produce the best coffee the water must be precisely heated; experts argue a temperature change of only one degree has a noticeable effect.

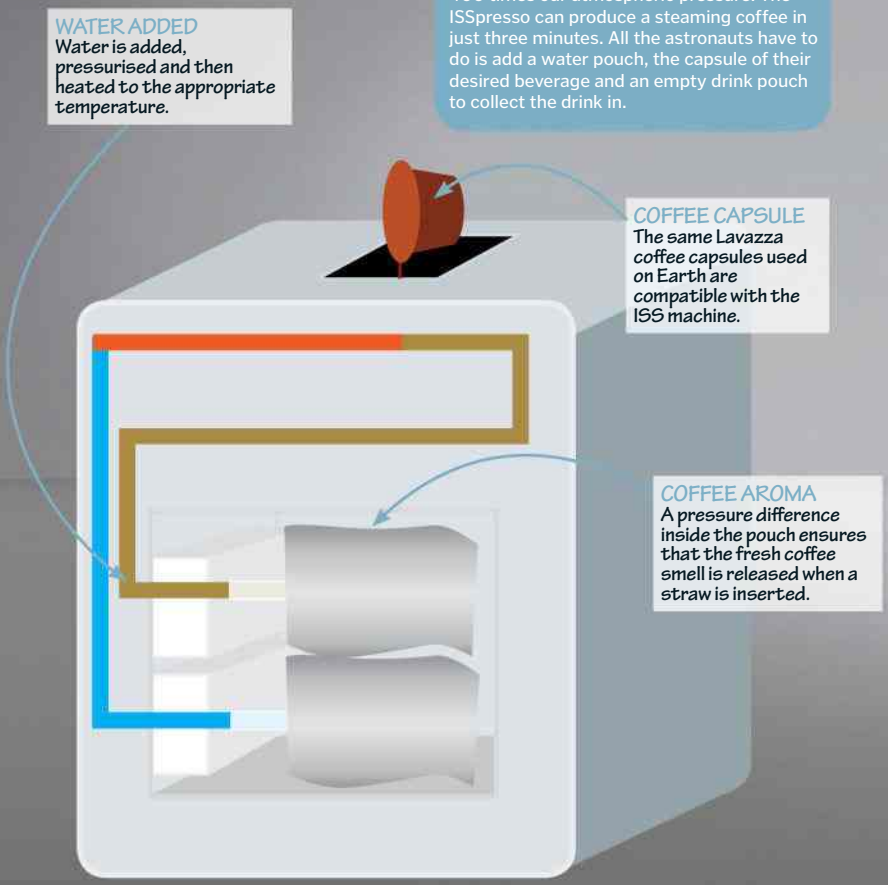
Typically, a jet of hot water between 88 and 93 degrees Celsius (190 and 200 degrees Fahrenheit) passes through the ground coffee at a pressure of nine atmospheres (nine times normal atmospheric pressure). Anything hotter will burn the coffee, giving it a more bitter taste. When espresso machines were first invented, pressure was created via a lever, which compressed the steam inside the machine manually. Modern machines have replaced this system with a set of pumps and valves, however, which compress the steam to create the required pressure automatically.

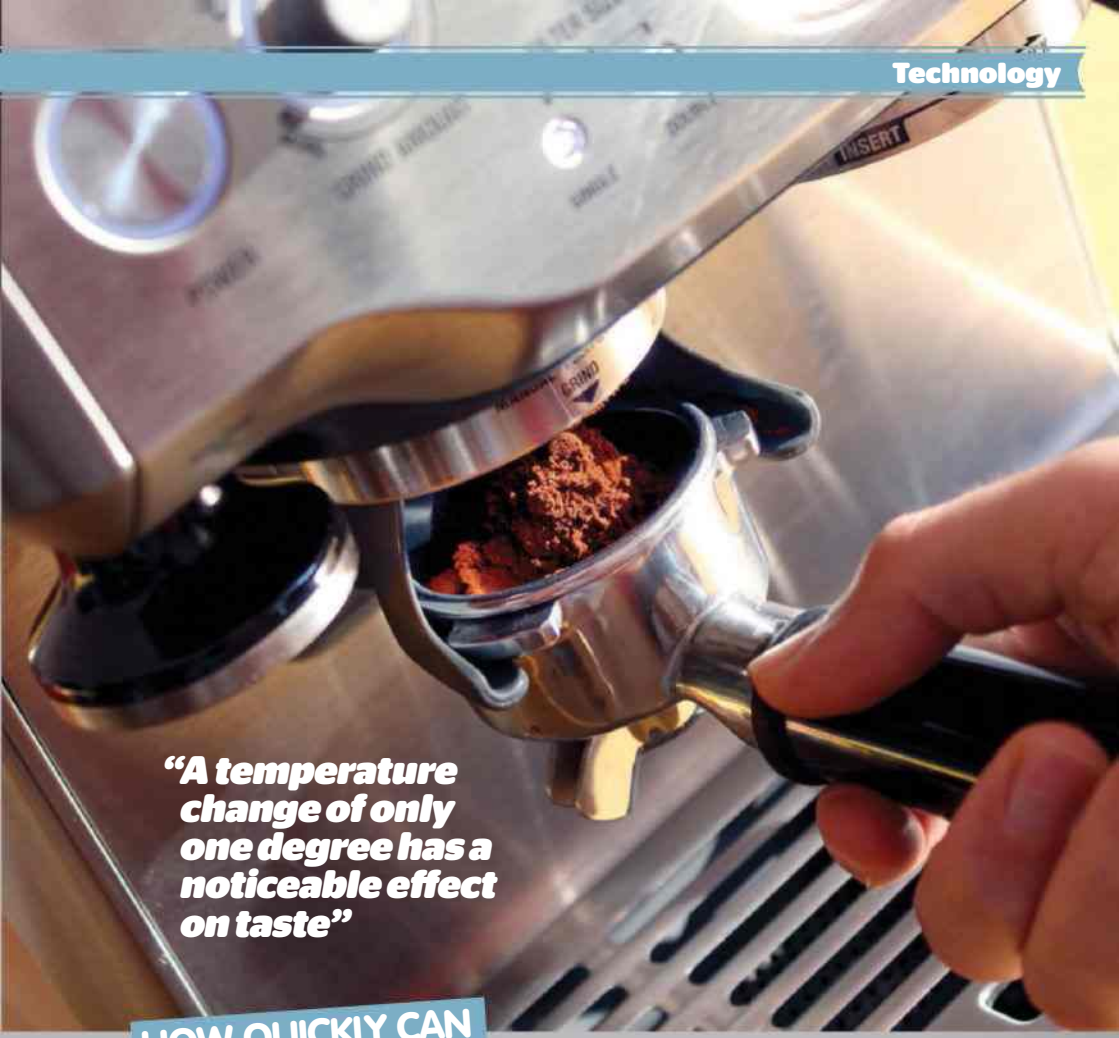
Inside an espresso maker, a boiler will bring water to the required temperature. Many machines draw cold water through a pipe within the

boiler in a heat exchange system. The the water within the pipe is heated by conduction until it reaches the perfect temperature. It is then forced through the coffee grounds at high pressure to extract the beans' flavour and aroma. Once filtered to remove the grounds, the coffee pours through the nozzle and into your cup, ready to enjoy. The boiler steam can also be directed to a steam wand and used to heat and froth milk for other beverages such as cappuccinos.

OUT-OF-THIS-WORLD COFFEE

Now crew members on the International Space Station can boldly brew where no man has brewed before. The Italian Space Agency teamed up with Argotec and Lavazza to build a microgravity coffee machine – the ISSpresso. The entire design for a typical appliance had to be re-engineered because fluids behave very differently in space. For example, much higher pressures are required to produce the same result as an Earth-based machine. The plastic tube that normally carries water had to be replaced with a steel version, capable of withstanding 400 times our atmospheric pressure. The ISSpresso can produce a steaming coffee in just three minutes. All the astronauts have to do is add a water pouch, the capsule of their desired beverage and an empty drink pouch to collect the drink in.





"A temperature change of only one degree has a noticeable effect on taste"

HOW QUICKLY CAN YOU MAKE A COFFEE?

For many coffee lovers, the faster they can get their hands on a brew, the better. The AeroPress device boasts a new method of producing an espresso-strength coffee in less than a minute. After placing the device on top of a mug and filling it with coffee and hot water, you insert the plunger and press down slowly but firmly to force the water through the ground beans. Bored of waiting for his drip coffee maker to deliver the goods, inventor Alan Adler developed the plunging method and fine paper filter to produce a high quality taste.

Inventor Alan Adler's AeroPress device can deliver high-quality coffee in less than a minute

How do noise-cancelling headphones work?

ACTIVE NOISE-CANCELLING

How does the system hear, analyse and block unwanted sound?

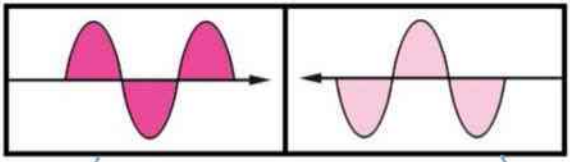
Illustration by Tom Connell

+ *Active noise-cancelling headphones can block out up to 70 per cent of background noise*

If you've ever tried listening to music on a flight, you'll be familiar with battling the constant droning of the jet engines. Noise-cancelling headphones can reduce this ambient sound, helping you to enjoy listening to music or watching an in-flight movie. There are two ways to achieve this effect, known as active and passive noise reduction. The latter is the simplest method, as it blocks sound waves with layers of high-density foam. This is good for masking high frequency sounds such as a loud bang, but the headphones will struggle to stop resonances at a lower frequency.

Active noise-cancelling headphones also use special materials, but go one step further and create their own sound waves too. Tucked inside the earpiece is a small microphone that detects ambient sound and feeds it to a digital processor, which analyses the sound wave's composition. It uses this information to create a sound wave that's the complete opposite of the one it analysed. This 'anti-sound' wave has the same sized peaks and troughs as the background noise, but they are inverted.

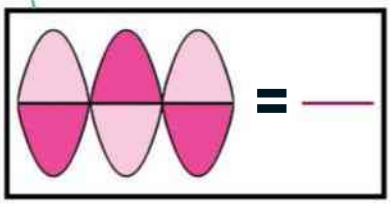
These anti-sound waves are then played back from a small speaker in the ear cup, actively blocking the ambient sound waves through a phenomenon known as destructive interference. When the incoming sound wave is at a peak, the anti-sound wave is at a trough, and the sum of these two waves adds to zero, resulting in minimal external sound reaching the wearer's ears.



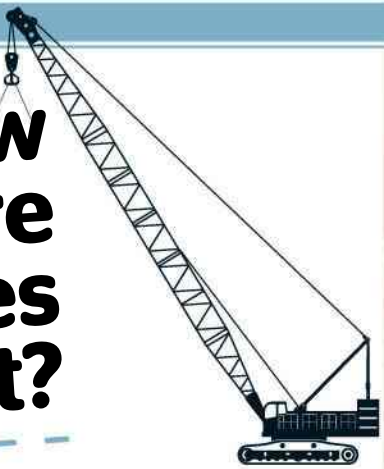
NEW SOUND WAVES
The peaks and troughs of the anti-sound waves are the inverted versions of those of the ambient sound.

AMBIENT SOUND WAVES
The height of a sound wave's peaks indicate its volume, while the frequency determines the pitch.

CANCELLING OUT UNWANTED SOUND
The new sound waves are exactly 180 degrees out of phase with the unwanted noise, cancelling it out by producing an 'opposite' sound.

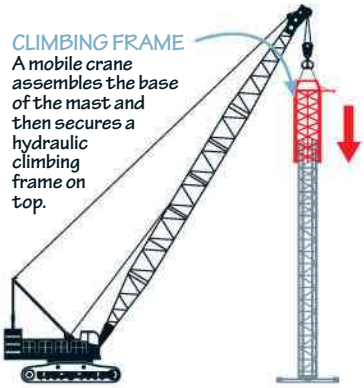


How are cranes built?

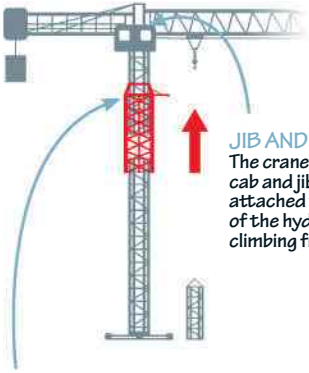


GROWING TALLER

How a crane grows with the building it is constructing

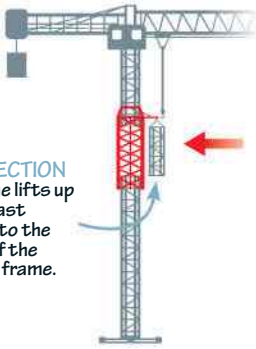


CLIMBING FRAME
A mobile crane assembles the base of the mast and then secures a hydraulic climbing frame on top.

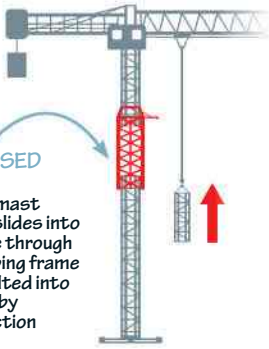


JIB AND CAB
The crane operator's cab and jib arm are attached to the top of the hydraulic climbing frame.

HYDRAULIC JACKS
When the crane needs to grow taller, hydraulic jacks lift up the climbing frame, creating space for a new mast section.



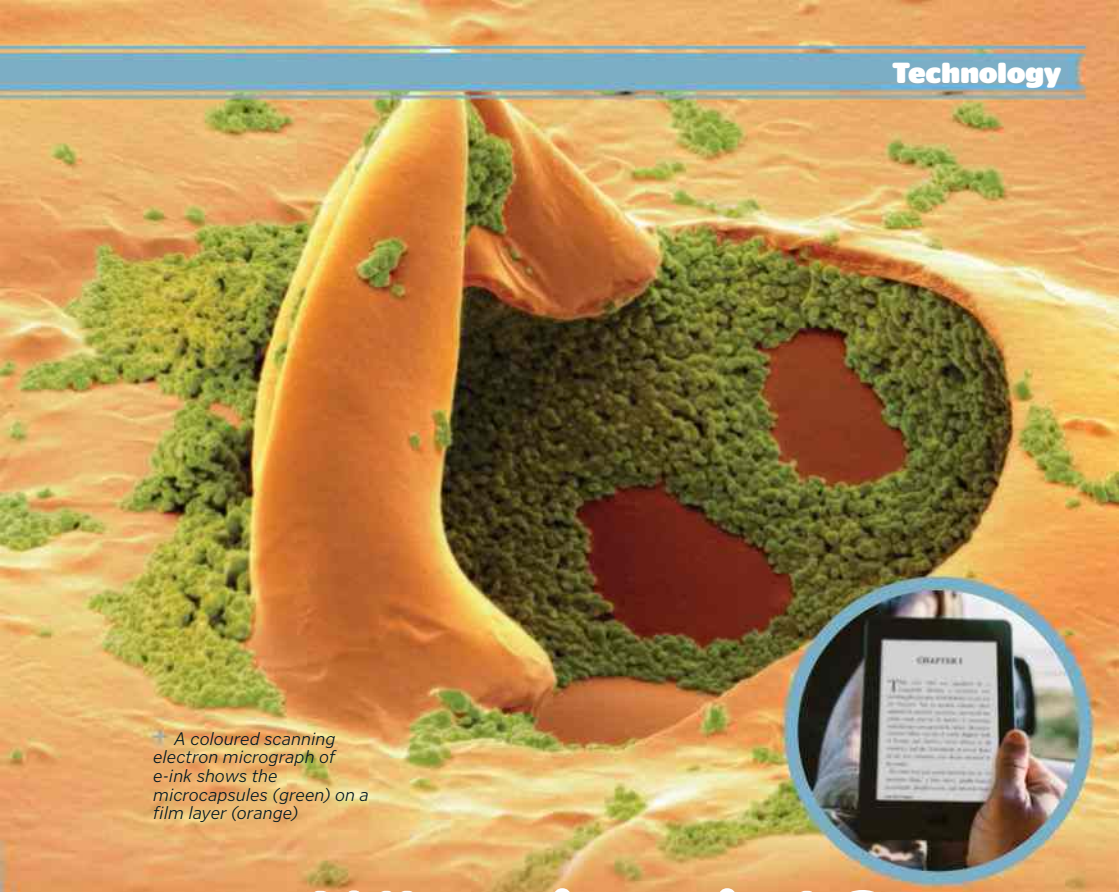
NEW SECTION
The crane lifts up a new mast section to the height of the climbing frame.



INCREASED HEIGHT
The new mast section slides into the place through the climbing frame and is bolted into position by construction workers.

As it happens, the only thing capable of building a crane is another crane, with just a little help from man and machine. The first building stage involves pouring 180 tons of concrete into the ground to form the base that the steel mast is embedded into and ensure stability. Once the concrete has set, a small mobile crane builds the first section of the mast and attaches a horizontal arm, called a jib, on top. From here, the crane builds itself, slotting in new mast sections until it reaches the desired height.

Unsupported, a typical crane can reach around 80 metres (265 feet) in height, but even greater heights are achievable if they are tethered to a building for support.



A coloured scanning electron micrograph of e-ink shows the microcapsules (green) on a film layer (orange)

What is e-ink?

E-readers use electronic paper displays containing electronic ink. This e-ink is made up of millions of tiny microcapsules, each about the diameter of a human hair, sandwiched between two layers of transparent film and electrodes. Each microcapsule contains positively charged white particles and negatively charged black particles suspended in a clear fluid. When the electrode beneath the microcapsules applies a negative electric charge, the negatively charged black particles are repelled to the top of the capsule, making the film above appear black. Then, when a positive charge is applied, the white particles are repelled, making the film appear white. By applying the correct charge at different points across the display, black text and graphics can be formed, with the microcapsules acting like pixels on a computer screen.

A major benefit of an e-ink display over a traditional LCD screen is that it doesn't need a backlight, so power is only required when the display is changed. This helps to extend the device's battery life, and also prevents eyestrain typically caused by staring at backlit screens for long periods of time.

Some hand dryers blow air towards you at over 640km/h (400mph)

What goes on inside a hand dryer?

Most modern hand dryers contain a heating element that's activated either by the push of a button, or the triggering of an infrared motion sensor. The versions with infrared sensors are much more environmentally friendly, as they ensure that the dryer isn't left running unnecessarily once the user has left, saving both energy and money.

The heating element inside a hand dryer is made of Nichrome (an alloy of nickel and chromium) that heats passing air by up to 50 degrees Celsius (90 degrees Fahrenheit). Once the hot air has been created, it's quickly channelled through a pipe and expelled at high pressure onto your wet hands. The pressure of the air is enough to blow water directly off them, while the warmth dries out the moisture.

Concerns have been raised over whether or not hand dryers are hygienic. Modern versions have High Efficiency Particulate Air filters built in, to remove 99.97 per cent of disease-causing germs from the air they blast out. However, some studies have shown that dryers can blow bacteria from people's hands into the surroundings if they have not been washed properly.

Why do boomerangs come back?

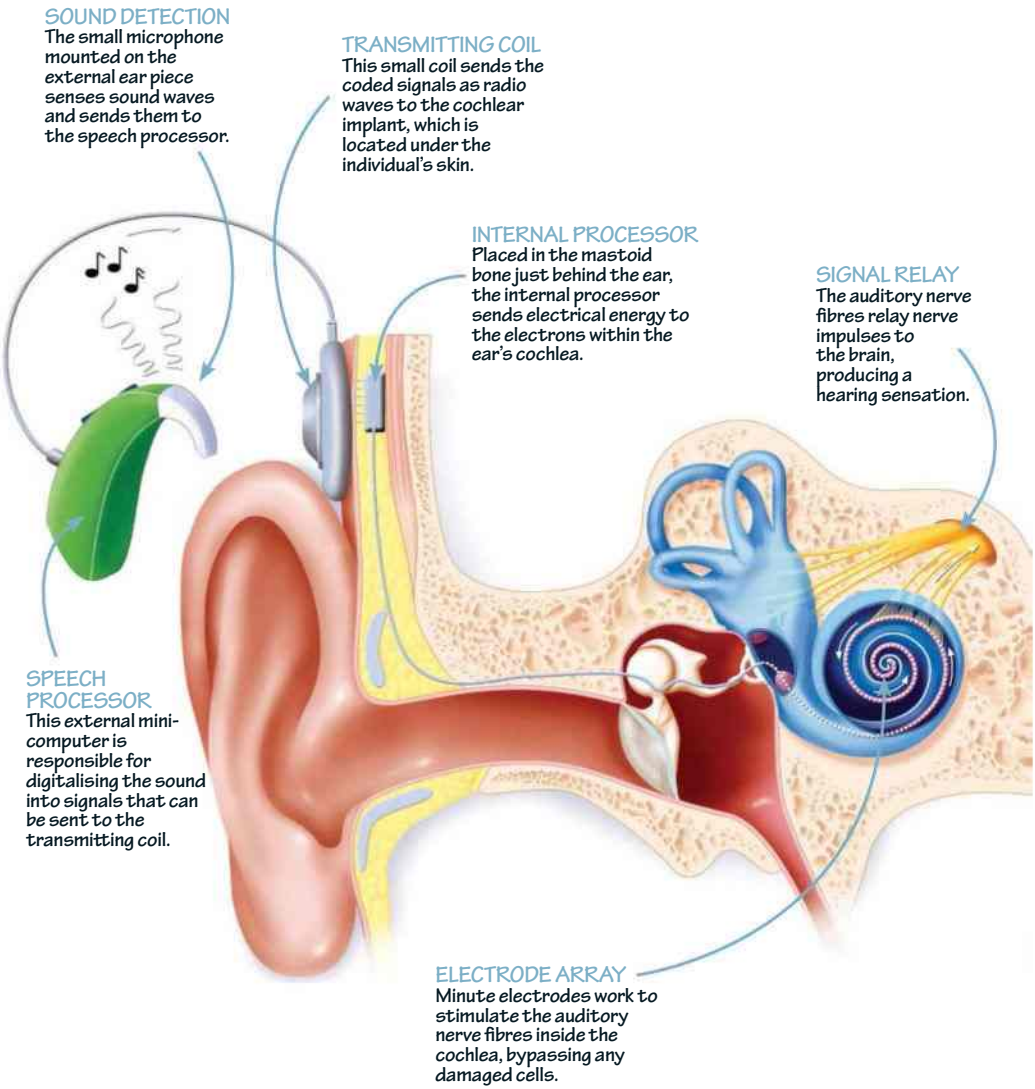
A boomerang is a spinning, L-shaped wing. It flies because the air flowing over the aerofoil shape of the wing generates lift. But the trailing arm of the L is flying through the disturbed air in the wake of the leading arm, so it gets less lift. This creates a twisting force that tries to bank the boomerang over to the side. Since it is also spinning, the boomerang acts like a gyroscope, which makes it fight the twisting force and travel in an arc instead. Right-handed boomerangs arc around anticlockwise as they make their way back to the thrower.

Boomerangs combine the aerodynamics of a helicopter blade, a gyroscope and a frisbee

How do you fix a human ear?

It is believed that the ability to hear evolved in animals as an early warning system, but for humans it provides so much more. Unfortunately, some people are born with little or no hearing ability, and many more struggle with faded hearing as they get older. Thanks to the brilliance of modern science, however, many of these people can now use a hearing aid to revitalise this crucial ability.

Traditional hearing aids essentially work by boosting the volume of the sound that reaches a person's ear, much like guitar amplifiers boost the instrument's sound. Although this technique works well, it is relatively low-tech compared to some of the hearing solutions that are available today. One such device is the cochlear implant, which enables sound to be transferred directly through your auditory (hearing) nerves to the brain. This tends to be a much more effective solution than a hearing aid, allowing patients to reconnect with sounds they previously struggled to



hear and better understand other people's speech.

Only one fifth of people who could benefit from a hearing aid seek help, which illustrates just how commonplace this technology could become in the near future. The stigma of needing to wear one is far outweighed by the possible benefits, especially as they are increasingly discreet and mostly hidden from view. In the future it might be possible to completely regenerate the cochlea, making hearing aids redundant and returning the joy of sound to many.

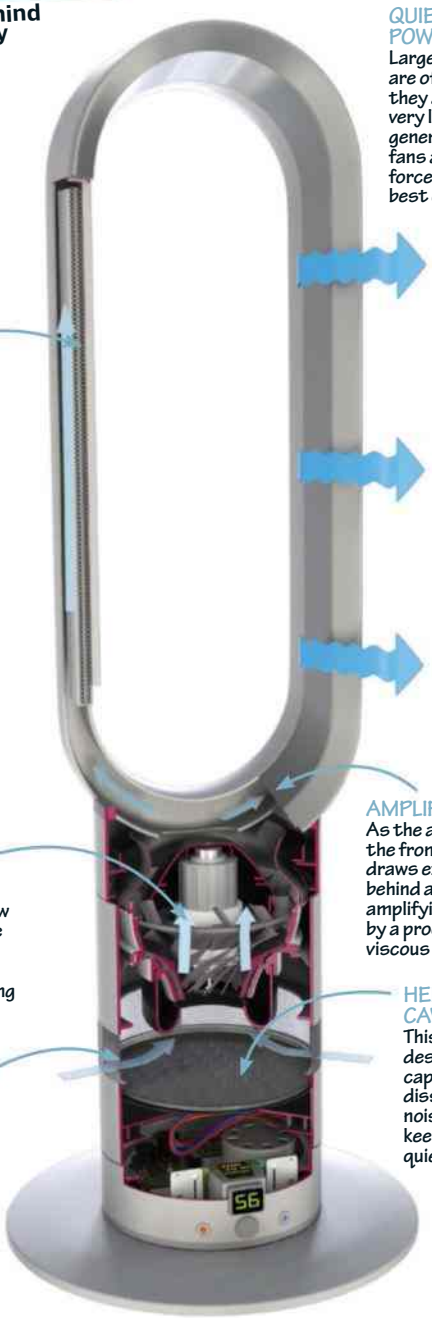
How do bladeless fans blow air?

Despite appearances, a bladeless fan does actually have a small, concealed fan inside its main body. The way it uses this to produce a stream of cool air is very different from normal models, though. A traditional fan's blades chop the air as it is sent towards you, creating a rather turbulent breeze and lots of noise. A bladeless fan provides a much smoother, constant stream of air which will gently, and quietly, cool you down. Other than the airflow itself, bladeless fans have several advantages. They are more energy efficient than air conditioning units or conventional fans, and are much easier to clean. They also lack external spinning blades, which can cause injury to curious children.

Bladeless fans are more energy-efficient than traditional models

WHAT'S INSIDE?

The secret behind the technology



QUIET YET POWERFUL

Large conventional fans are often powerful, but they are typically also very loud. The latest generation of bladeless fans are both quiet and forceful; you get the best of both worlds.

AEROFOIL PROPULSION

The air is shot through a 1.3mm (0.05in) slit, which speeds it up to 88.5km/h (55mph).

AMPLIFIED AIRFLOW

As the air jets out of the front of the fan, it draws extra air from behind and to the sides, amplifying the airflow by a process known as viscous shearing.

IMPELLER

The fan's mixed flow impeller forces the air to flow quickly and at high pressure, increasing the fan's power.

HELMHOLTZ CAVITY

This brilliantly designed housing captures and dissipates motor noise, helping to keep the fan as quiet as possible.

AIR ENTRY

Inside the fan's main body is an electric motor that sucks air in through small vents at its base, working like a vacuum cleaner in reverse.

Illustration by Nicholas Forder

Who decides which emojis are made?

Mobile phone manufacturers do. The little pictures of things like a dog or a slice of cake were popularised by Japanese mobile networks and don't have any official translation or meaning. Around 1,300 emojis have subsequently been adopted by the Unicode standard, and theoretically anyone can submit a proposal to unicode.org for a new one to be added. But the review process takes about two years and there is no requirement for mobile phones to only use standard Unicode emojis. Apple, for example, has their own set that are used on iPhones and these aren't licensed to anyone else.

Why does swimming pool water irritate your eyes?

Goggles can protect you from the chloramines formed in pool water

Chlorine in pool water reacts with sweat, urine, bacteria and oils to form compounds which can irritate eyes. Chlorine is added to the water in order to kill bacteria and other disease-spreading organisms, but does not cause irritation itself. As it reacts with nitrogen and ammonia, it forms chloramines, compounds which can irritate eyes, lungs and skin, and are also responsible for that typical swimming pool smell. The more chloramines that are formed, the less effective the chlorine is at disinfecting the water. By showering before entering the pool, swimmers can avoid introducing substances that lead to chloramines being produced.

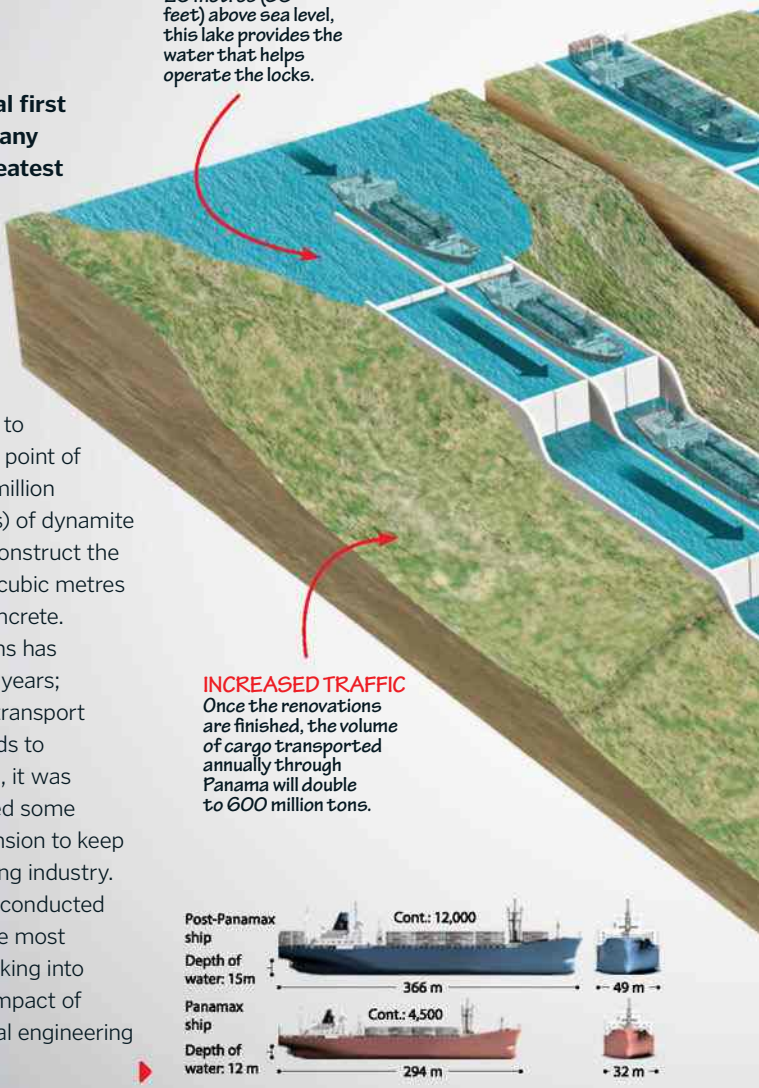
Cookies are a way for websites to remember you. If a site needs to keep some info (eg your 'shopping basket') then it saves a unique serial number on your computer in a little text file called a cookie. Every time your browser requests a page from a website, it looks to see if there is a relevant cookie and sends it if there is. Cookies can be useful because they enable sites to remember your login details, but they are also controversial because advertisers can use them to track which sites you visit. Use a 'private browsing' mode to avoid storing any cookies.

THE NEW PANAMA CANAL

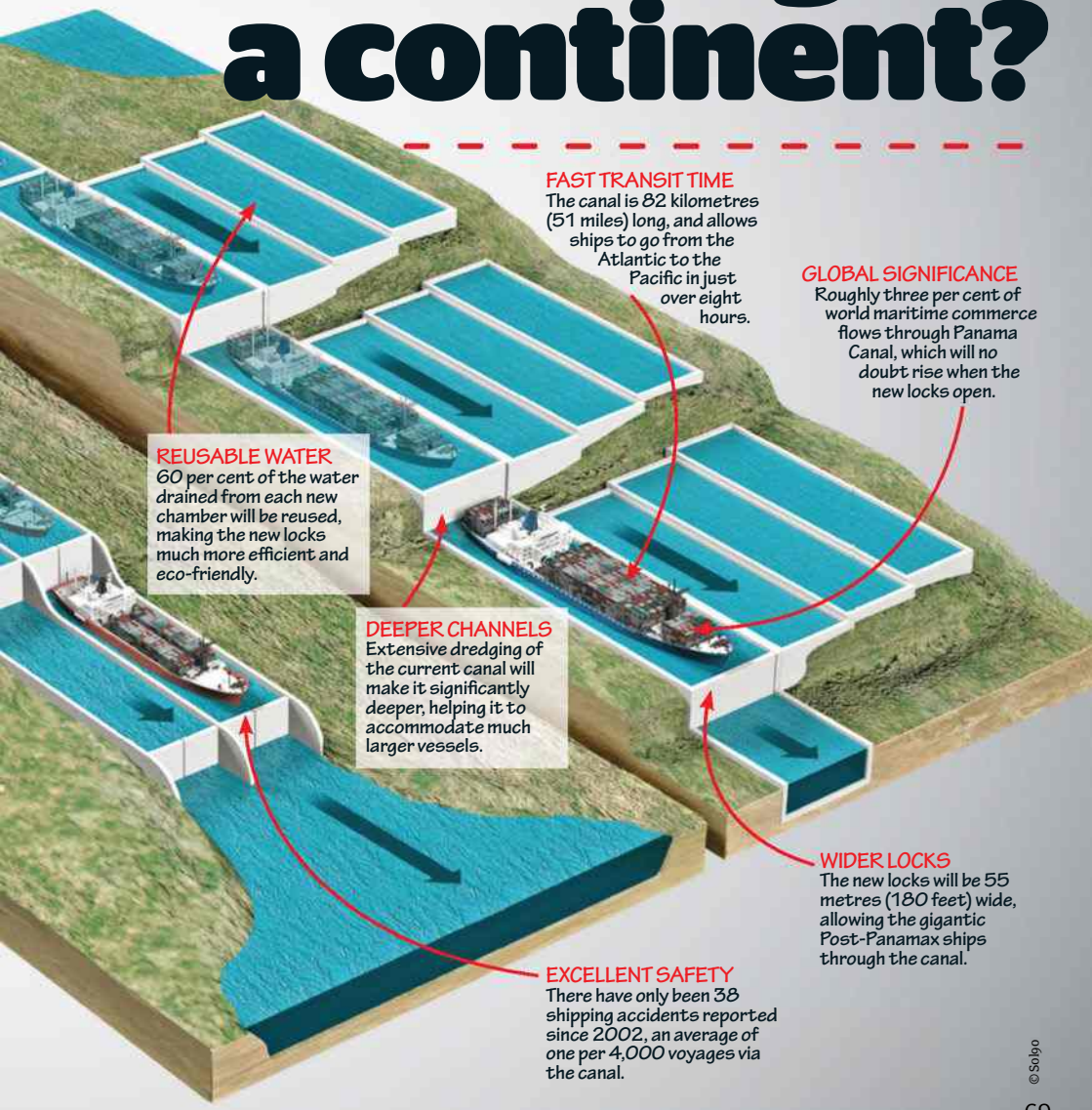
See how the new design will compare to the old once it is completed

When the Panama Canal first opened in August 1914, many considered it to be the greatest engineering feat ever accomplished. It allowed ships travelling between New York and San Francisco to cut their journey by a colossal 12,669 kilometres (7,872 miles), as they no longer had to go around the southernmost point of South America. Roughly 27 million kilograms (60 million pounds) of dynamite were used to excavate and construct the canal, along with 3.8 million cubic metres (135 million cubic feet) of concrete.

Traffic in the world's oceans has quadrupled over the past 20 years; mammoth cargo ships now transport 95 per cent of imported goods to American shores. Due to this, it was decided that the canal needed some serious renovation and expansion to keep pace with the modern shipping industry. More than 100 studies were conducted to find out what would be the most appropriate plan of action, taking into account the environmental impact of the changes and the technical engineering that would be required.



How do ships cut through a continent?



FAST TRANSIT TIME
The canal is 82 kilometres (51 miles) long, and allows ships to go from the Atlantic to the Pacific in just over eight hours.

GLOBAL SIGNIFICANCE
Roughly three per cent of world maritime commerce flows through Panama Canal, which will no doubt rise when the new locks open.

REUSABLE WATER
60 per cent of the water drained from each new chamber will be reused, making the new locks much more efficient and eco-friendly.

DEEPER CHANNELS
Extensive dredging of the current canal will make it significantly deeper, helping it to accommodate much larger vessels.

WIDER LOCKS
The new locks will be 55 metres (180 feet) wide, allowing the gigantic Post-Panamax ships through the canal.

EXCELLENT SAFETY
There have only been 38 shipping accidents reported since 2002, an average of one per 4,000 voyages via the canal.

A £3.5 billion ($5.25 billion) project has been devised, which will involve four major components: a Pacific access channel, an additional set of locks, improvements to the water supply and enhanced navigation channels. Once complete, the canal will be able to support a third lane of traffic, and will be roomy enough to allow ships almost three times the current maximum size permitted, carrying 2.5 times the number of containers. Passage through the new locks will not be cheap for the largest vessels, which currently pay hundreds of thousands of dollars to pass through.

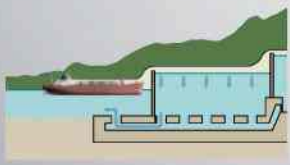
The renovations were scheduled to be completed in 2015, but a considerable number of issues have resulted in delays. Nevertheless, the canal's improvements will have a huge impact; trade will become more efficient as it will require less time, money and fuel to get products to American ports. Much of the intercontinental traffic will no doubt flock to Panama to take advantage of this, boosting American economy much like it did when it opened in 1914.

The Panama canal offers a direct route between the Atlantic and Pacific Oceans

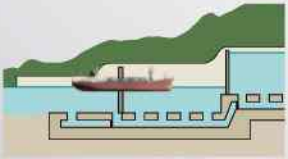
PANAMA CANAL'S TWO-WAY LOCKS

See how Panama's original locks work to transport ships from one side to the other

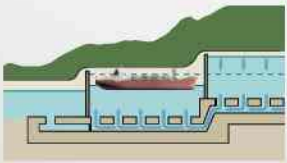
1 The first lock chamber releases 100 million litres (26 million gallons) of freshwater into the ocean, levelling out the water level so that it matches that of the sea.



2 Once the water levels have evened out (which takes around eight minutes) the lock gates open and the ship enters the first chamber. The valves and gates are then closed.



3 Water is released from the second chamber into the first, levelling them up so that the ship can enter the second chamber. This process continues until it reaches the other side.



The Suez Canal was the first man-made canal ever constructed, and was opened in 1869

COMPETITION FOR PANAMA?

The Panama Canal is starting to face fierce competition from around the world. Egyptian president Abdel Fattah el-Sisi announced plans to add an extra lane to the Suez Canal, which runs through Egypt to connect the Mediterranean Sea with the Red Sea, in 2014. It was completed in a third of the originally estimated time and has allowed two-way traffic, doubling the canal's capacity to an average of 97 ships each day. It has also slashed transit time almost in half, from 18 hours to 11.

The Suez is not the only canal trying to get in on the action; there is likely to be a new contender in the coming years. One Chinese entrepreneur has announced plans for a £33 billion ($50 billion) Nicaragua Grand Canal, which would connect the Atlantic to the Pacific through Lake Nicaragua. This canal would be 278 kilometres (173 miles) long and able to accommodate some of the biggest ships in the world, carrying enormous containers. Construction is planned to take five years, but at the time of writing it has not yet started.

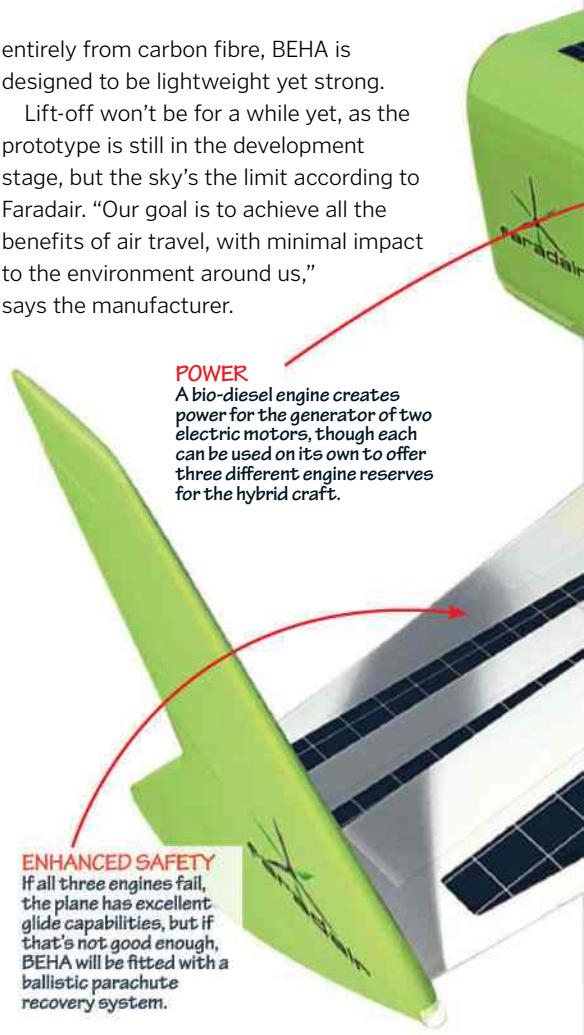
How do you build a truly green aircraft?

In the last decade the travel industry has witnessed a huge swing in favour of more environmentally friendly vehicles. While the likes of Tesla have pioneered hybrid and electric technology in road vehicles, the drive for more efficient travel has also taken to the skies. When it comes to reinvention of light passenger aircraft, there are few more innovative than the Bio-Electric-Hybrid-Aircraft (BEHA).

The product of Faradair Aerospace – in partnership with Prodrive and Cranfield University – seeks to lower costs while offering safer operational capability with lower noise and emissions. There are three engines on board BEHA, with one bio-diesel engine effectively powering two electric motors – though the plane can be flown purely on the bio-diesel reserve engine. This improves its safety in the event of engine failure. Solar skin panels will ensure greater energy generation and recovery during flight, in a bid to reduce emissions.

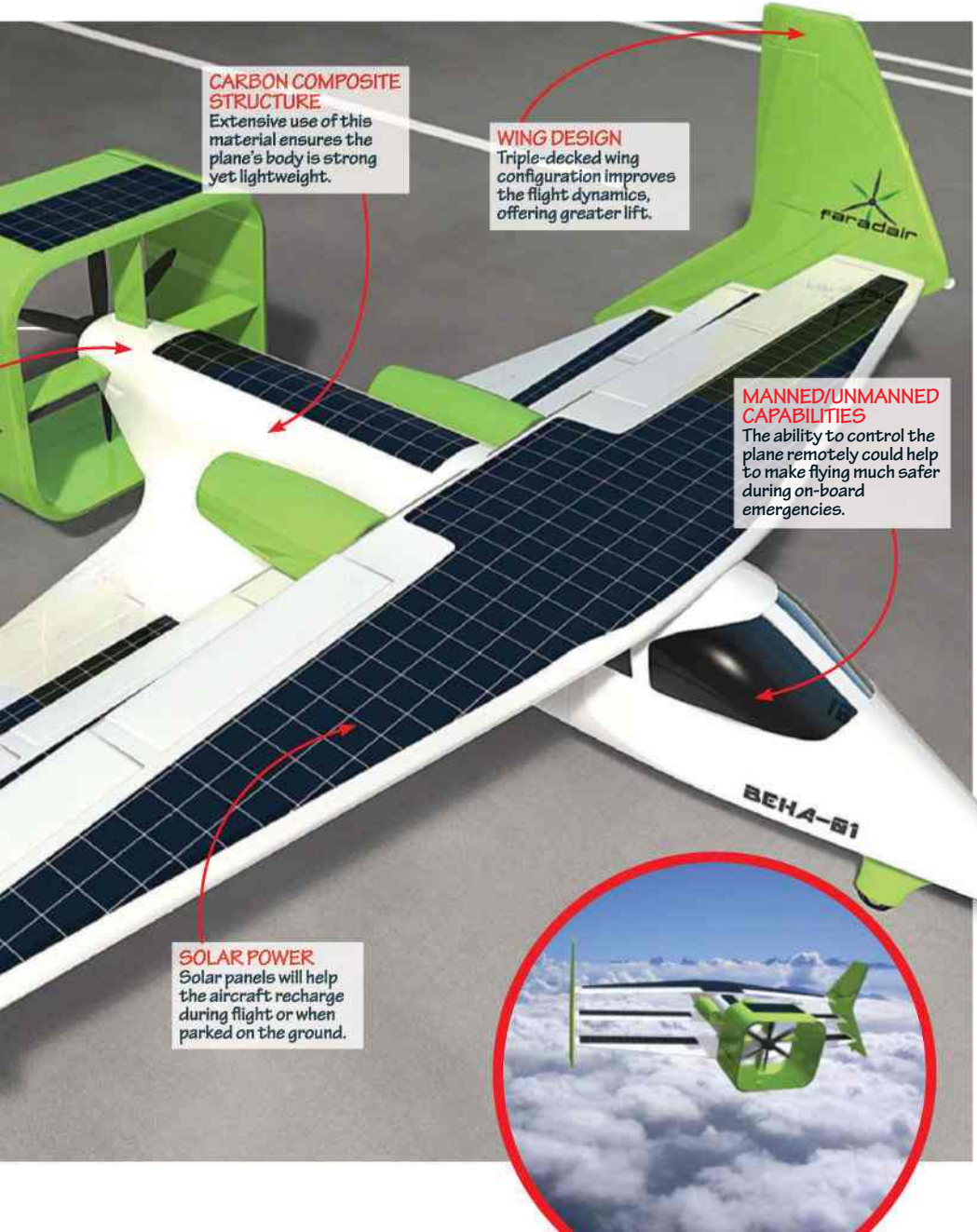
What's more, the plane can take off and land on pure electric energy for reduced flight noise, ensuring it can be used around the clock, even in urban areas where night restrictions may apply. It's not just the plane's power source that breaks with tradition, either. Made entirely from carbon fibre, BEHA is designed to be lightweight yet strong.

Lift-off won't be for a while yet, as the prototype is still in the development stage, but the sky's the limit according to Faradair. "Our goal is to achieve all the benefits of air travel, with minimal impact to the environment around us," says the manufacturer.



GREEN SKIES AHEAD

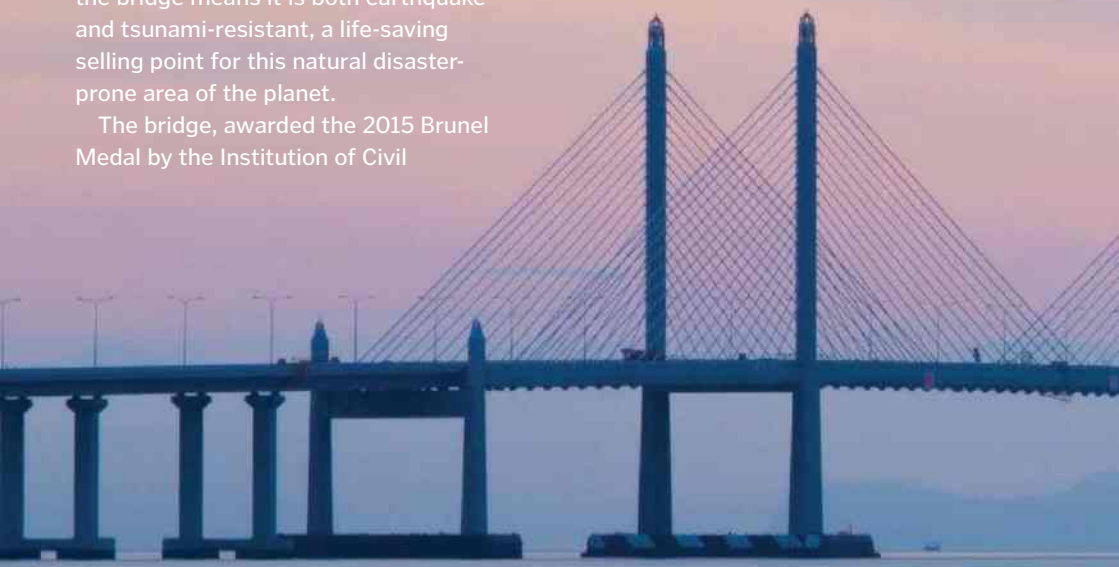
Here's why the crowdfunded BEHA is the next big thing in aviation



How can a bridge survive a tsunami?

Few man-made structures can survive the unforgiving wrath of Mother Nature, but the Second Penang Bridge in Malaysia can lay claim to just that. Innovative technology used in the construction of the bridge means it is both earthquake- and tsunami-resistant, a life-saving selling point for this natural disaster-prone area of the planet.

The bridge, awarded the 2015 Brunel Medal by the Institution of Civil Engineers, is rooted into position by a series of wide, pre-cast concrete pylons mounted at a world record depth of 127 metres (417 feet). Cables are connected to the pylons using third-generation saddles (the blocks at the top of the



In an area prone to natural disaster, the Second Penang Bridge will save lives

The bridge is the longest sea crossing in Southeast Asia

bridge over which the cables pass), improving their structurally efficient hold. The 24-kilometre (14.9-mile) bridge, which will take motorists approximately 20 minutes to cross, has a curved appearance when viewed from above. This is to reduce traffic accidents, forcing drivers to reduce their speed and concentrate on the curve of the road – keeping the whole area safe from erratic drivers as well as the elements.

How is air kept fresh in aeroplanes?

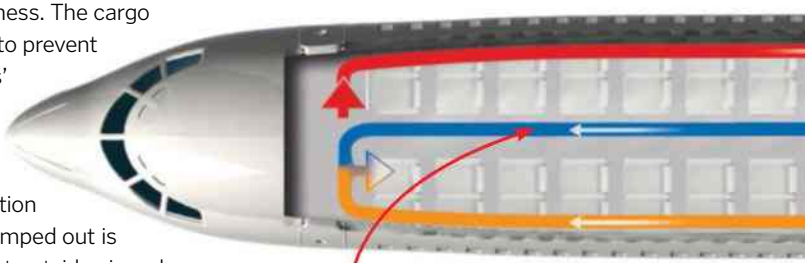
At 12,000 metres (39,000 feet), oxygen pressure is so low that even breathing pure oxygen doesn't transfer enough into your blood. This is why all airliner cabins are pressurised, and need an air supply pumped into them to maintain our most vital life process. If the cabin were to depressurise at this altitude, you'd have approximately 15 seconds to get your oxygen mask on before losing consciousness. The cargo hold is also pressurised to prevent items within passengers' luggage leaking, expanding or bursting.

In a standard commercial air recirculation system, the air that's pumped out is composed of 50 per cent outside air and 50 per cent re-circulated air. The recycled air isn't simply pumped back around the cabin; it goes through a complex cleaning process to remove bacteria, fungi, dust, fibres and odours. This 50/50 mix ensures that the chance of germs spreading is kept very low while also guaranteeing optimal fuel economy for the plane.

The outside component of this mixture is provided by the engines, which take in some of the surrounding air as they fly and compress it. This compression heats the air, so it is cooled and filtered before being mixed with the recycled cabin supply. Sensors regulate the rate at which outside air is added to the cabin to maintain optimum air pressure, allowing passengers and crew to breathe easy.

INSIDE THE SYSTEM

See how planes suck in outside air, clean it and use it in their cabins

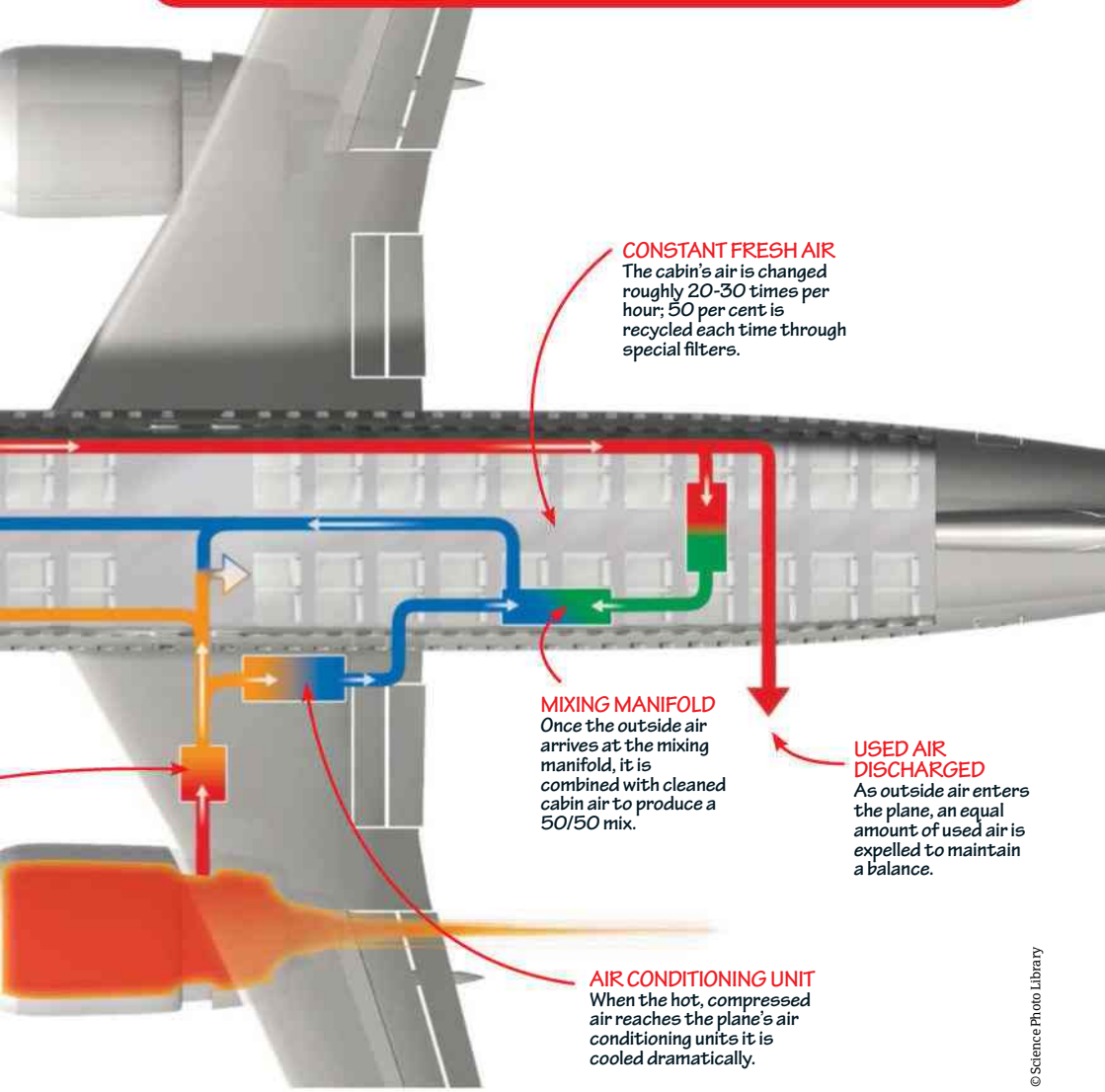


AIR CIRCULATES THE CABIN
The air leaves the mixing manifold and enters the cabin, where it's supplied via overhead outlets.

AIR ENTERS
As air enters through the aircraft's jet engines, it becomes incredibly hot as it is pressurised.

THE TRUTH ABOUT AIR INSIDE PLANES

People dread flying for a number of different reasons, whether it's a fear of confined spaces or potential disasters. A surprisingly common aspect of flying that makes people nervous is the thought of getting ill, but is cabin air as rancid as people think? Thankfully, the answer is no. Recent studies have shown that a crowded airplane is no more germ-filled than any other typical enclosed space; they are actually more likely to be cleaner. This is partly due to the underfloor, high-energy particulate air (HEPA) filters, which are said to be of hospital quality by their manufacturers. Boeing claim that as much as 99.9 per cent of airborne microbes are captured and removed from the air on their aircraft, and that the air is replaced much more frequently than in an office, classroom or cinema.



Can the Sun power a car?

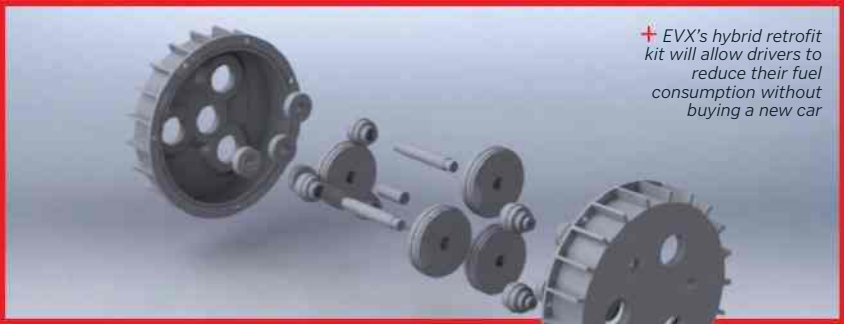
This solar-electric sports car is the brainchild of a small company called EVX, which is working on a prototype for the end of 2016. The car will absorb the Sun's energy via almost seven square metres (75 square feet) of photovoltaic cells spread across its roof, and will also feature a plug-in electric powertrain, complete with a lithium-ion battery pack. Measuring five by two metres (16.4 by 6.6 feet) it's not small, but has enough room for two people plus hand luggage.

By combining a fully charged battery and the Sun's rays, the Immortus will have a range of over 550 kilometres (342 miles) when travelling at 85 kilometres (53 miles) per hour. However, if you slow the average speed down to 60 kilometres (37 miles) per hour, it will be possible for it to keep going all day, limited only by the availability of sunshine. Its ability to store power while in motion will be hugely significant, helping it to deliver excellent performance when needed, reaching a top speed of over 150 kilometres (93 miles) per hour.

There is still much work to be done before the Immortus can become a reality; EVX are seeking funding of almost £1 million ($1.5 million) in order to start production. Once they have obtained this funding they are expected to make only 100 units, which will retail for an estimated £326,000 ($500,000). At least prospective buyers will save on fuel!

INSPIRING FUTURE TECHNOLOGY

While designing the solar car technology that will feature in the Immortus, EVX have identified several innovations that could be incredibly useful to car manufacturers around the world. One such technology is a hybrid retrofit kit, which will convert petrol-powered vehicles into plug-in hybrids, giving owners the ability to make older cars environmentally friendly. This kit will also increase acceleration after breaking and turn conventional two-wheel drive cars into four-wheel drive. EVX have also theorised a lightweight, air-cooled battery box, which is essential for the Immortus and could soon be applicable to the aeronautic and mining industries, as they are likely to rely on electric technology in the future. The designers also want to develop small cameras to replace wing mirrors, as this will reduce air resistance and make future electric cars even more efficient.



EVX's hybrid retrofit kit will allow drivers to reduce their fuel consumption without buying a new car

The Immortus will be a 40kW composite roadster, weighing around half a ton

Why is a ship's speed measured in knots?

Early sailing ships measured their speed by throwing a floating anchor overboard and measuring out the line it was attached to. This line was knotted every eight fathoms (about 14.4 metres/47 feet) and the sailor counted the number of knots that passed through his fingers in the 28-second interval of a standard ship's hourglass. There are approximately 1,000 fathoms in a nautical mile (1.85 kilometres/1.15 miles), so one knot was extremely close to one nautical mile per hour. Nowadays the knot is defined to be precisely a nautical mile per hour, and it is still useful because maritime charts mark distances in nautical miles.

Efficient sailing uses the minimum effort to achieve the maximum knots

+ To pilot the Sky you can connect it to a range of apps

Could drones replace the postman?

In some cases they already have! Flytrex is the world's first cloud-connected delivery drone. Capable of transporting packages weighing up to one kilogram (2.2 pounds), the Flytrex Sky is also fitted with a 3G module, allowing it to maintain an internet connection throughout its flight. To pilot the Sky manually, you can connect it to a wide range of apps available on both iOS and Android devices.

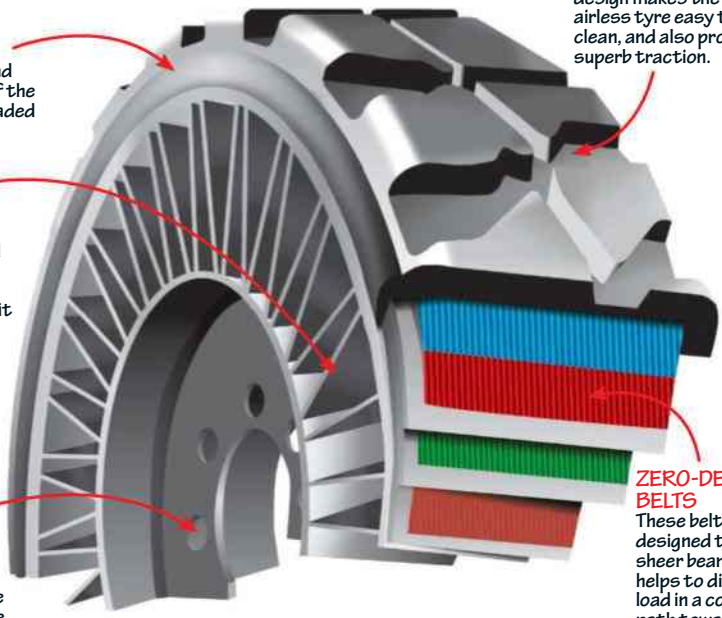
If you feel like relinquishing control, this clever quadcopter also features an autopilot system. In order to transport a package autonomously from A to B, it relies upon GPS (global positioning system) to pinpoint its exact location. This works like any GPS-enabled device – by receiving radio signals from satellites. There are about 30 satellites orbiting Earth and each one transmits information about its position and current time. Based on this data, the drone can work out exactly where it is at any time and adjust its course accordingly.

When the drone reaches its destination, the recipient can either let the Sky land by itself, or take over manual control to help guide it down to the ground.

©Flytrex

INSIDE AN AIRLESS TYRE

See the features that make the Tweel so durable



Can a tyre run without air?

Michelin's airless tyre design promises to put an end to frustrating slow punctures and dangerous high-speed blow-outs. Their new 'Tweel' is a combined wheel and tyre assembly in a single, tough unit, primarily designed for commercial use in landscaping, agriculture and construction. If successful, the tech could be implemented in other vehicles.

Solid, air-free tyres have existed for a while but as they are incredibly hard, the vehicle bounces when travelling over rough terrain. The Michelin Tweel combats this by compressing when driving on rugged roads. Another advantage is that it's more eco-friendly than air-filled pneumatic tyres, as it is made of a plastic resin that can be repeatedly recycled. This means these tyres will have very little environmental impact even when they are replaced.

We are many years from seeing this type of wheel design on road cars, but the prospect of flat tyres becoming a thing of the past will excite all motorists.

What makes a parking meter tick?

Since the first parking meter was installed in Oklahoma in 1935, they have spread throughout the world, as cars became the dominant mode of transport. In the UK alone, parking meters provide revenue in the region of £500 million ($762 million) each year, just from on-street parking.

For cash payments, the meter identifies each inserted coin by conducting a set of pre-programmed tests, which include weighing the coin and testing its physical properties using electrical currents or lasers. This helps to distinguish between the different types of metal used to create the coins.

In America, the process is often simplified by accepting only one type of coin, most commonly the quarter. Parking meters in the US commonly only monitor one space; modern versions do this with the help of special sensors that use lasers to determine when the space has been vacated. Once it is vacated the clock is automatically reset to zero, so that another car can't use someone else's parking time for free. Individual parking meters are largely being replaced by modern pay-and-display meters, as they take up less space and can be powered by solar energy.

More and more parking meters are now accepting electronic payments, and some even use pre-loaded smart cards

Diesel and petrol: what's the difference?

A diesel internal combustion engine looks nearly identical to its petroleum-powered counterpart. However, fuel is ignited differently in the combustion chamber of a diesel engine.

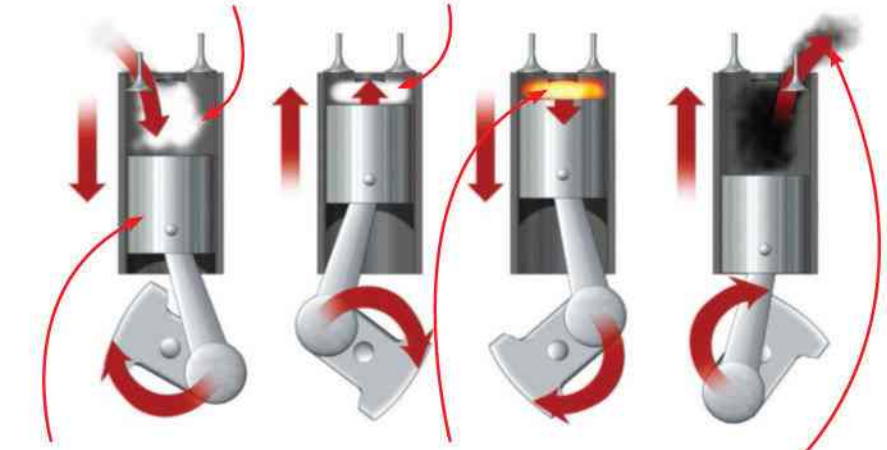
An internal combustion engine works by creating mini explosions in the combustion chamber of each cylinder. This pushes a piston downwards, spinning the crankshaft it's attached to. The rotational energy from the crankshaft is then transferred to the vehicle's wheels, propelling it forward.

Most internal combustion engines are four-stroke, meaning a four-step process takes place in the combustion chamber: intake, compression, combustion, and exhaust.

Broadly, both diesel and petrol engines follow the four-stroke cycle, though the 'combustion' differs hugely. In a petrol engine, the spark plug ignites the petrol and air mixture, while in a diesel engine, fuel is injected at high pressure into the hot, compressed air in the cylinder, causing it to burn rapidly and forcing the piston down.

CYLINDER
Engines usually contain multiple cylinders, where the intake, compression, combustion and exhaust processes take place.

COMPRESSION
As the crankshaft spins round, the piston is pushed back up, forcing the air to compress.



INTAKE
Air is forced into the cylinder at high pressure via an intake valve, forcing the piston down.

COMBUSTION
The compression heats the air, so much so that when the diesel fuel is injected, it instantly ignites. The explosion forces the piston back down.

EXHAUST
As the piston goes back down the cylinder, the exhaust valve in the top opens to let out the 'spent' exhaust gases. The cycle starts again with 'intake'.

Plymouth University, Shuttleworth Design and MSubs have developed the vessel

Can a ship sail without a crew?

Named after the famous ship that once took pilgrims from England to America, the Mayflower Autonomous Research Ship (MARS) will have a much lonelier journey. Powered by renewable wind, ocean current and solar energy, it will replicate this historic journey with no crew, using only GPS and collision avoidance systems to navigate.

Two sails will enable it to move at 37 kilometres (23 miles) per hour, but on calmer days these will be stowed away so that more light can reach the solar panels. These will then power an electric motor with a top speed of 23 kilometres (14 miles) per hour.

The ship will gather meteorological, oceanographic and climate data using a team of onboard drones, and is due to set sail from Plymouth, UK in 2020, the 400th anniversary of its namesake's voyage. It will take seven to ten days to cross the Atlantic.

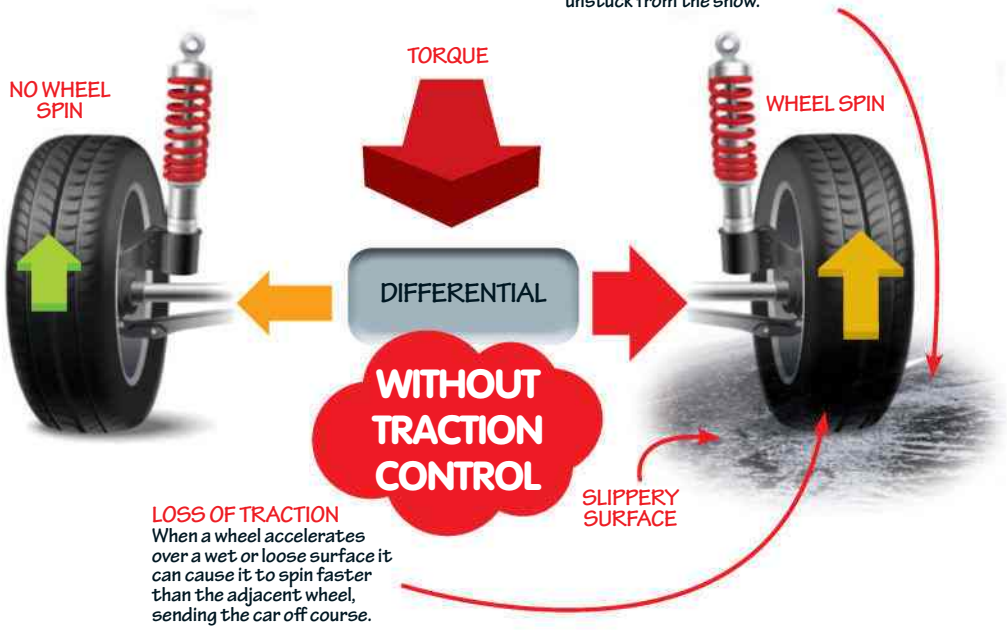
How do you stop a car from skidding out of control?

It may look cool in a Bond film, but wheel spin can be very hazardous, reducing your ability to accelerate and causing loss of control. To combat this, Buick designed traction control, which first featured in its cars in 1971.

Modern traction control systems use sensors to constantly measure wheel speed, as part of the car's anti-lock braking system (ABS). This allows it to immediately recognise when one of the wheels is spinning faster than the others

TRACTION IN ACTION

Find out how this system stops your wheels from spinning out of control



– a sign of traction loss – and reduce the power of the spinning wheel until it matches the others. This works to straighten the car out if it has started hydroplaning on water, or skidding on a slippery surface.

Traction control may sound perfect, but there are times when it doesn't work. Most traction control systems fail to function on ice, because when two or more wheels are struggling to gain traction, the system can get confused and make things worse. Having said that, there are very few occasions where traction control should be turned off: only when you are stuck in snow or plan on racing!

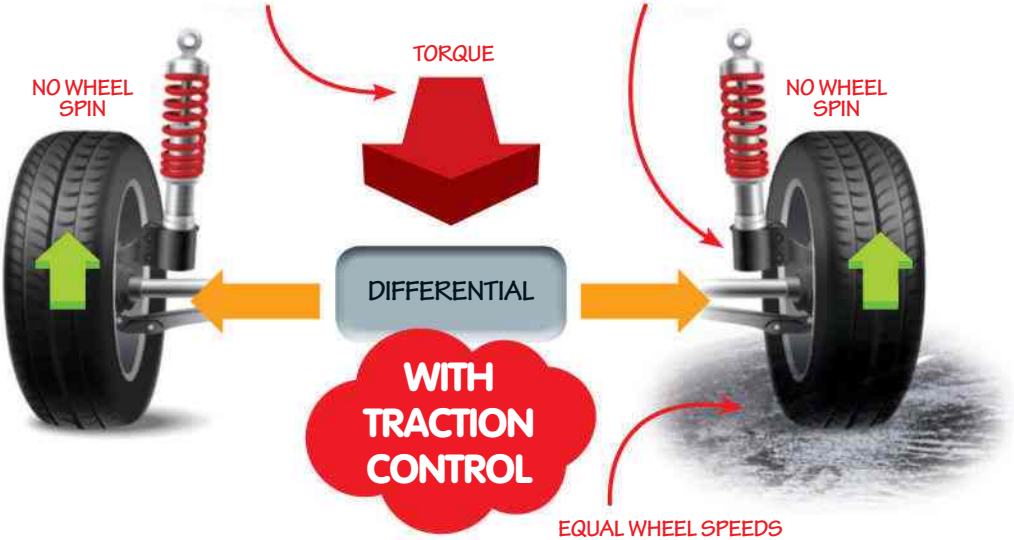
+ *Skidding is more likely in wet weather, or when tyres are underinflated*

ADVANCED TRACTION CONTROL

Some four-wheel drives have more sophisticated systems that control the amount of power fed to each wheel.

PUMPING THE BRAKES

Essentially the reverse of ABS, traction control slows the wheel down by using a pumping action on the wheel's brake.



EQUAL WHEEL SPEEDS

Once both wheels are spinning at the same speed and have equal torque, there is less risk of losing control.

How were Native American tipis built?

+ *The Oglala Lakota tribe was one of those that made tipis their home*

It's a common misconception that all Native Americans lived in these iconic cone-shaped tents; in fact, only the indigenous people of the Great Plains and Canadian Prairies built tipis. These tribes were reliant on wild bison for food, clothing, shelter and tools, so followed their migratory route across the North American plains, regularly moving their camps from place to place. It was therefore essential that their lodgings could be erected and dismantled quickly to suit their nomadic lifestyle.

The solution was the tipi, which is now largely out of use except for ceremonial purposes. These mobile homes were made from wooden poles with a buffalo skin covering, and had openings at the top to allow smoke from the open fire inside to escape. These flaps were positioned at right angles to the wind to prevent a downdraft, and it was this feature that distinguished the tipi from all other conical tents. The poles could be used to

THE WIGWAM

Often confused with tipis, wigwams (or wickiups) were dome-shaped dwellings created using a frame of arched wooden poles. Unlike tipis, these were often built as permanent homes for the Native American tribes, as they took longer to put up and were not usually portable. Their curved shape made them ideal for withstanding different weather conditions, from howling winds to torrential rain. The frame was made from young tree saplings three to 4.6 metres (ten to fifteen feet) long that were cut down while they were malleable enough to be bent into shape. Local materials were used to make the roof, ranging from grass, bark and reeds to hides or cloth. When the wigwam reached the end of its life, it was burned down and a new one erected in its place.

form a travois (a kind of sledge), which could then be attached to a horse and dragged along while carrying supplies and people at the same time – ideal for hunters who were always on the move.

Not only were they designed for portability, but tipis could also adapt to the drastically changing seasons of North America. The animal skin coverings kept the inside of the tent warm during the winter and cool during the summer, and they could also withstand strong winds and heavy rain. The base of this skin was pegged to the ground with a gap at the bottom during warmer seasons to allow airflow. In winter, a liner was fitted inside the tipi, which could be stuffed with grass for added insulation.

ANATOMY OF A TIPI

Each tent was cleverly constructed for comfort and practicality


STICKING TOGETHER
Lodgepoles were tied together at the top using raw hide or rope.
SHAPE AND SIZE
Tipis had a diameter as small as two metres (6.6 feet) or as large as 12 metres (39.4 feet). The conical structure could withstand strong winds.
ANIMAL SKIN
Historic tipis had coverings made from bison hide. They kept the tent cool in summer, warm in winter, and dry during rainy periods.
ENTRANCE
Tipis faced east, towards the rising Sun. When the door was closed, visitors had to announce themselves and wait for permission before entering.
HIDES
Bison hides were stretched out, the flesh removed and the hair shaved off. They were then tanned using the bison's brains.
CAMPFIRE
A fire was used for cooking food, heating water and keeping warm in winter.
PETS
Over time, wolves slowly developed into domesticated dogs, which were used for hunting, hauling, and kept simply as pets.

What was it like inside a Victorian household?

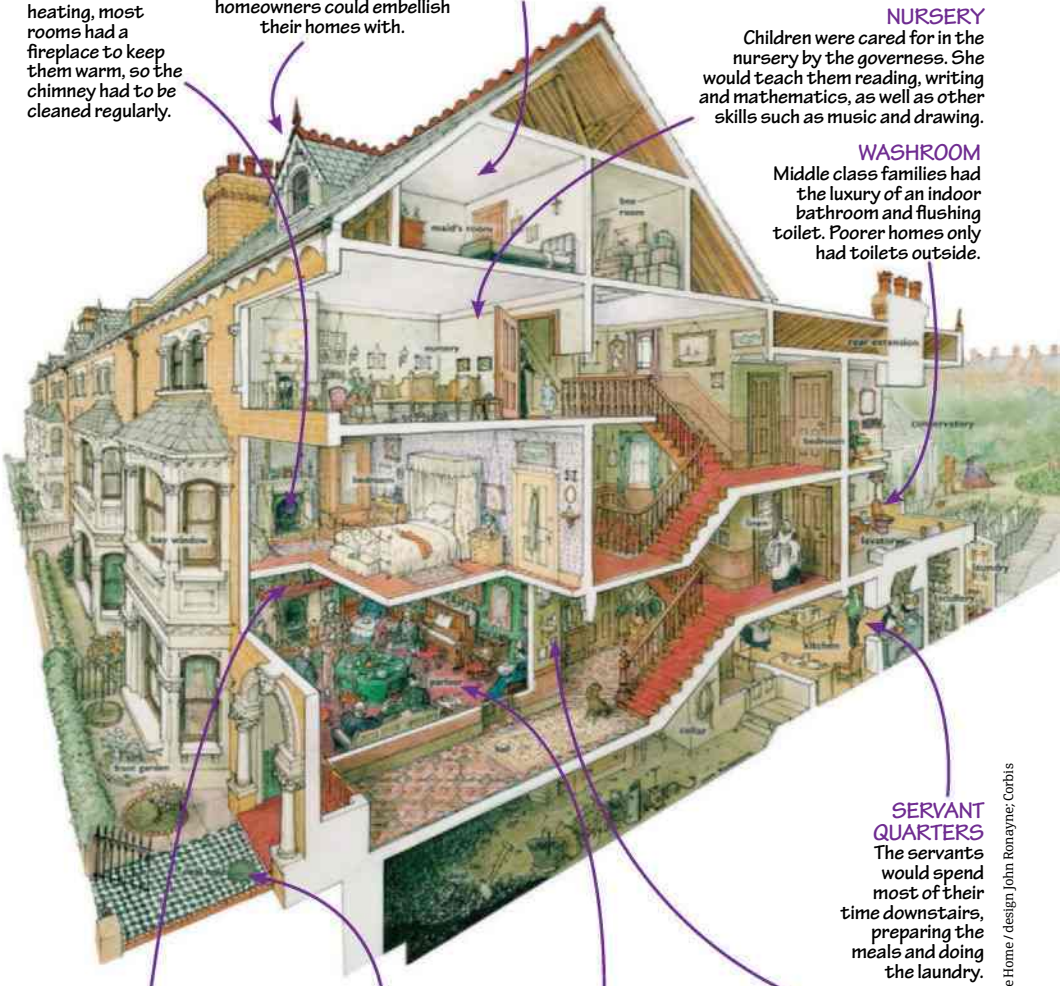
Many Britons benefitted from greater manufacturing, consumerism and overseas trade during the Industrial Revolution. Increased wealth elevated many from the working classes, creating a new middle-class population.

With occupations ranging from lawyers to shopkeepers, middle-class men could afford to move their families to the suburbs and commute into the city. Their homes were usually large terraced houses, with front and back gardens and plenty of room for the family and a few servants to live comfortably. The number of servants a family employed was a big indicator of their wealth, with most homes having at least one maid, one cook and a gardener. Servants were provided with clothing, food and living quarters, and in return they would work long hours for a meagre wage.

Managing the staff was often the job of the lady of the house, as middle-class women rarely worked. Instead, most of their time was spent entertaining, shopping and socialising, while a governess looked after their children. The governess was employed to raise the youngsters with good manners and give them a basic education so that they could later follow in the footsteps of their parents.

GRAND DESIGNS

Take a tour of a traditional terraced house



HEATING
Without central heating, most rooms had a fireplace to keep them warm, so the chimney had to be cleaned regularly.

ELEGANT EXTERIOR
With the Industrial Revolution came mass-produced and imported products that homeowners could embellish their homes with.

MAID'S ROOM
Live-in servants had their own room, usually on the top floor or in the attic, which was often cold in winter and stuffy in the summer months.

NURSERY
Children were cared for in the nursery by the governess. She would teach them reading, writing and mathematics, as well as other skills such as music and drawing.

WASHROOM
Middle class families had the luxury of an indoor bathroom and flushing toilet. Poorer homes only had toilets outside.

SERVANT QUARTERS
The servants would spend most of their time downstairs, preparing the meals and doing the laundry.

DECORATION
Flowery wallpaper and carpets were very popular among the middle-classes, with ornaments and paintings providing the finishing touches.

COAL HOLE
Coal for the fireplaces was delivered regularly through the coal hole, sending it straight into the cellar.

PARLOUR
This was where guests were entertained, so the room was often decorated lavishly to indicate the family's social status.

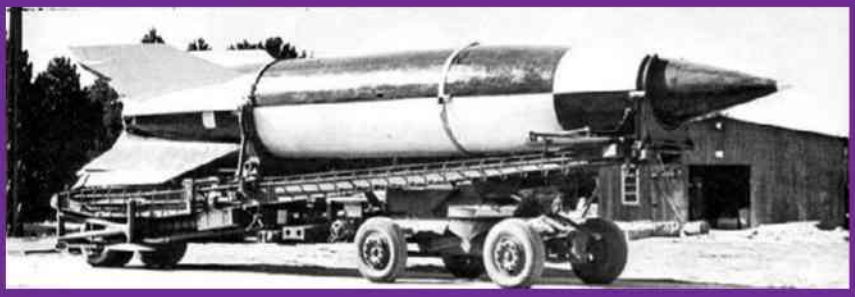
LIGHTING
Candles and gas lamps would illuminate the house, as electric lights were not widely used until the end of the Victorian era.

Were there drones back in World War II?

Now synonymous with modern warfare, the roots of today's sleek and sophisticated unmanned aerial vehicles (UAVs) actually stretch back almost a century. With World War I (1914-1918) providing a crucible for technological innovation, experiments began in unmanned flight. The result was an American 'aerial torpedo' called the Kettering Bug. A forerunner to the modern guided missile, it could carry an explosive warhead at up to 80 kilometres (50 miles) per hour. A timer could be set, shutting off the engine and dropping the wings so that it could plummet like a bomb, but military planners were wary of flying these inaccurate explosives over their own lines. In the run up to World War II (1939-1945), Britain's Royal Navy experimented with fitting wooden biplanes with radio control so that they could serve as target practice.

In 1933, the first flightless drone aircraft, called Fairey Queen, was tested. It crashed on two of three trials, but in 1934, Queen Bee, a modified Tiger Moth, followed with greater success.

DRONES THAT FIGHT



While 'aerial torpedoes' represented the destructive capability of drone technology – the end result being Nazi Germany's V-1 and V-2 rockets – the seeds of the concepts for modern UAVs were also sewn behind the red banners of the Third Reich.

Dr Fritz Gosslau proposed Fernfeuer in 1939 – a vision for a remotely-piloted plane, which could drop its payload and then return to base. Plans for Fernfeuer were halted in 1941, but they had already paved the way for development of the V-1 flying bomb.

In March 1944, the US Navy deployed the TDN-1 assault drone in the fight against Japan. On 19 October 1944 it successfully dropped bombs over targets in the Pacific. Unlike the planned Fernfeuer and current UAVs though, TDN-1 had no way of flying home.

BENEATH THE HOOD OF THE FIRST UAVS

EMPTY COCKPIT
The cockpit of the Royal Navy's Fairey Queen aircraft housed a pump in the rear which drove the pneumatic actuator motors.

ARTIFICIAL INTELLIGENCE
The Fairey Queen's mass-produced successor – the Queen Bee – could land itself if it lost radio contact.

STEERING TROUBLE
Without controls sophisticated enough to guide them, the ailerons – the flaps on the wing used to roll or bank the plane – were locked in a neutral position and the pilot had to steer using only the rudder.

REMOTE CONTROL
Rather than a modern joystick, a rotary dial like that on an old telephone transmitted commands by radio signal. Different numbers represented different directions.

BLAST OFF!
Many warships carried catapults for launching recon aircraft in the era before radar, reducing the amount of work for UAV pilots.

SPREAD YOUR WINGS
The Fairey Queen's wings had a larger dihedral – the upward angle of the wing in relation to the ground – which made the plane more stable. It crashed four times out of five, regardless.

Training gunners on these rudimentary models wasn't very realistic, but a solution soon came from the United States in the form of actor Reginald Denny, and his Radioplane Company. After years of trying to interest the US Navy in the Radioplane-1, Denny succeeded in 1939 and over the course of the war some 15,374 models were built. Fast, agile and durable, Radioplanes were fitted with responsive controls and were better able to mimic the speed and agility of enemy fighters.

Edmund Hillary (left) and Sherpa Tenzing Norgay (right) on their journey to the top of Everest

How was Mount Everest first climbed?

With just enough room for them to stand together side by side, Edmund Hillary and Sherpa Tenzing Norgay looked out at a view no one else had ever seen before. It was 11:30am on 29 May 1953 and they had just become the first people to ever reach the summit of Mount Everest.

Their journey began over two months before, when a team of 14 expedition members, led by British Army Colonel John Hunt, set off for Base Camp accompanied by 20 Sherpa guides and over 350 porters carrying thousands of kilograms of equipment. To complete the climb, the team established many camps along their route, some of which are still used by climbers today, and used special breathing apparatus to survive the thin air at high altitudes.

Along their journey, they had to scale glaciers, carve out paths in the ice and cross vast, dizzying crevasses, and many had to turn back when their oxygen supplies were depleted.

Eventually, Hillary and Norgay made it to the top, where they hugged with relief, planted flags and took some photos. They began their journey back down the mountain soon after to avoid running out of oxygen.

A TREACHEROUS ROUTE

How Hillary and Norgay climbed to the top of the world

THE SUMMIT
29 MAY
On 27 May, Hillary and Norgay begin their attempt and reach the summit two days later.

ALMOST THERE
26 MAY
Tom Bourdillon and Charles Evans set off for the summit, but have to turn back when their oxygen systems start to fail.

LHOTSE FACE
4 MAY
At 7,000 metres (23,000 feet), the team are faced with a 1,125-metre (3,690-foot) tall wall of ice.

WESTERN CWM
2 MAY
Reaching this bowl-shaped valley, also known as the Valley of Silence, is a welcome relief after the challenging Khumbu trek.

CAMP IV
24 APRIL
Equipped with several tons of supplies, all carried by the porters and Sherpas, the team finally reach Camp IV on 24 April.

CAMP II
15 APRIL
The team spend almost a week hacking out the route through the Khumbu glacier, returning back to Base Camp every night.

BASE CAMP
12 APRIL
30 days after starting their arduous journey in Kathmandu, the team establish Base Camp.

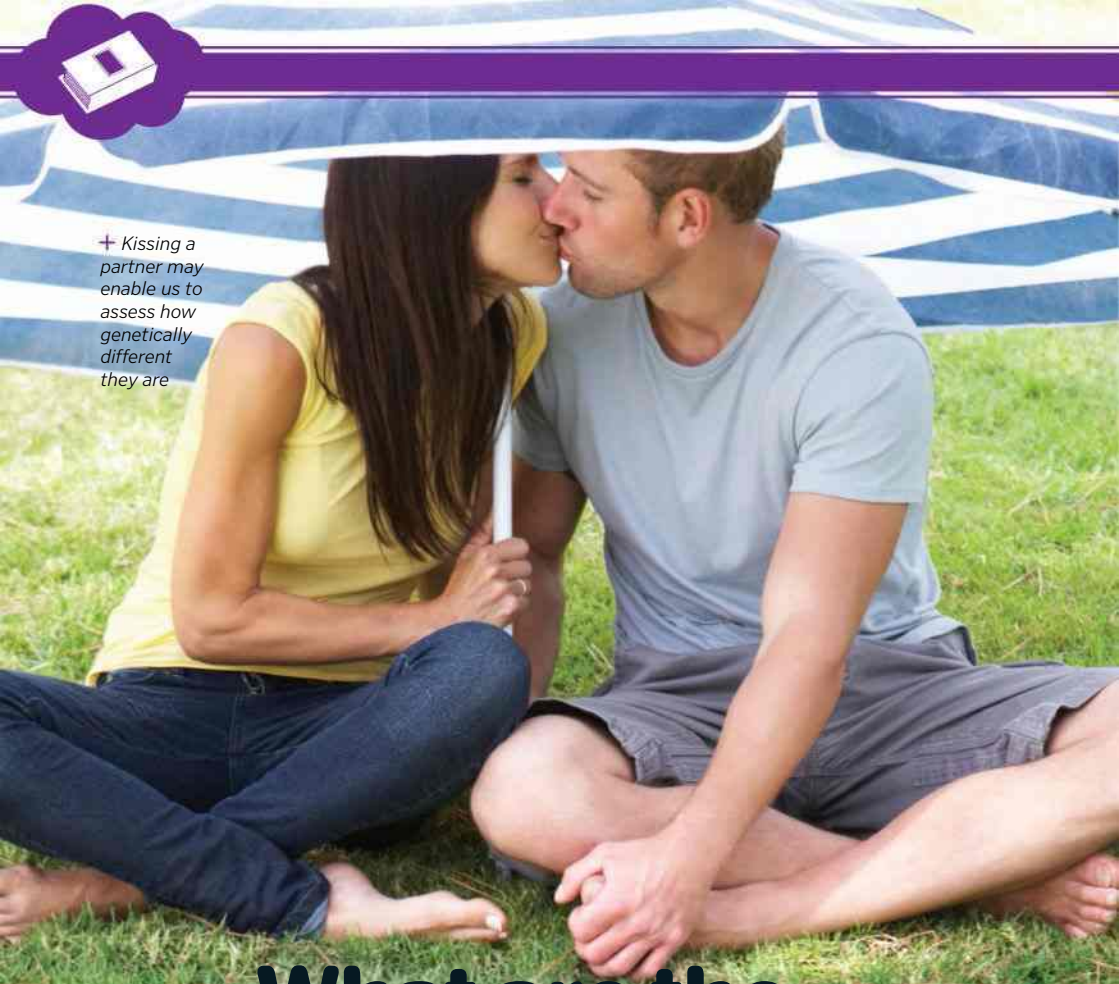
"A death-defying mission to conquer the world's highest mountain"

People often paint their faces with elaborate skull designs for Day of the Dead celebrations

How do you celebrate Day of the Dead?

Every year on the first two days of November, Mexican towns and cities are alive with colourful celebrations. A tradition that has developed from rituals dating back some 3,000 years, Día de Muertos (Day of the Dead) is a chance for people to remember and honour their deceased loved ones. Instead of mourning them with sadness, elaborate parties and parades are held to celebrate their lives with dancing, costumes and delicious feasts. Graves are decorated with flowers and candles, and altars are laden with offerings of food and drink for those that have passed away. Skulls, or calaveras, are the traditional symbol of the celebration and are typically depicted on masks or sweets that are eaten or given as gifts.

Although it is a Mexican tradition, Day of the Dead is also celebrated throughout Latin America and in parts of the United States. The festivities are split across two days, with 1 November as Día de los Inocentes – a day to remember children who have passed away – and 2 November for remembering deceased adult relatives.



Kissing a partner may enable us to assess how genetically different they are

What are the origins of kissing?

Several theories explain the origins of kissing; although the fact that not all human cultures kiss suggests that it is a learned, rather than an innate behaviour. One idea is that kissing stems from our early ancestors' practice of feeding babies directly from the mother's mouth. Another theory sees kissing as a means of evaluating who could be a potential mate. Coming into close contact lets us smell a partner's scent and pick up on subconscious clues about their genes. Finally, some believe that we kiss simply because it feels good: our lips are densely packed with nerve endings, making kissing intensely pleasurable.

What set off the Gunpowder Plot?

1 **Catholics are outraged** After taking the throne in 1603, King James I expels all Catholic priests from England, a Protestant state. English Catholics are furious and many begin to plot against the king.

The gunpowder plot begins
Guy Fawkes and 12 other Catholic gentlemen hatch a plan to blow up the Houses of Parliament in London to kill King James I and the Members of Parliament. They store 36 barrels of gunpowder in the cellar of the building, directly beneath the House of Lords.

3 **A letter reveals the plot** A letter sent to Lord Mounteagle (most likely from one of the plotters, Francis Tresham, who was his brother-in-law) warns him not to attend parliament on 5 November. This letter is revealed to the king, exposing the plotters' intent to kill him.

4 **The plotters are caught**
Guy Fawkes is caught in the cellar with the gunpowder, then tortured and forced to confess. His co-conspirators are also tracked down, and all the plotters are hanged, drawn and quartered, or killed while trying to escape. Guy Fawkes' head is placed on display as a warning to any other traitors.

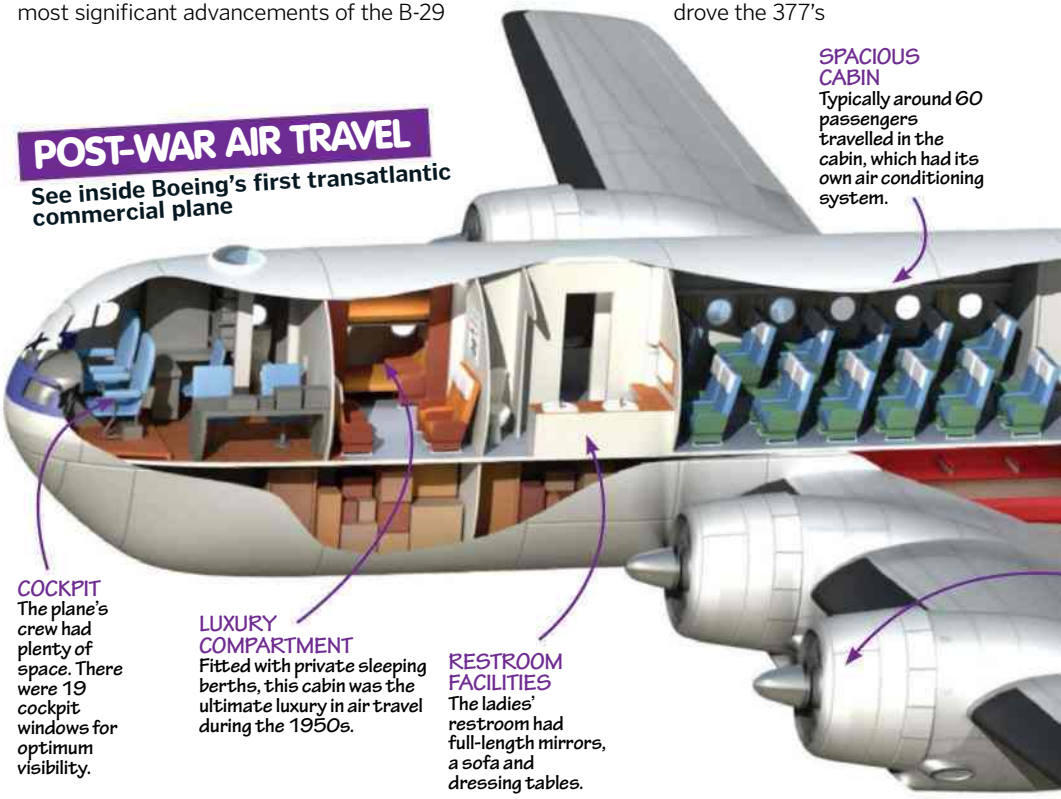
What was it like on board the original luxury airliner?

In the years following World War II, cutting-edge military technology was put to commercial use. In the late 1940s, Boeing unveiled the 377 Stratocruiser, an airliner based on the B-29 Superfortress Bomber, complete with the warplane's speed and design. One of the most significant advancements of the B-29 that the 377 utilised was Boeing's signature '117' airfoil design. The wings had flaps that could be retracted while flying to help minimise drag and allow higher speed, which kept flight durations as economical as possible.

Four 3,500-horsepower piston engines drove the 377's

POST-WAR AIR TRAVEL

See inside Boeing's first transatlantic commercial plane



SPACIOUS CABIN
Typically around 60 passengers travelled in the cabin, which had its own air conditioning system.

COCKPIT
The plane's crew had plenty of space. There were 19 cockpit windows for optimum visibility.

LUXURY COMPARTMENT
Fitted with private sleeping berths, this cabin was the ultimate luxury in air travel during the 1950s.

RESTROOM FACILITIES
The ladies' restroom had full-length mirrors, a sofa and dressing tables.

enormous propellers, helping it soar to a cruising altitude of 9,750 metres (32,000 feet). Piston engines are characterised by multiple tubes, each containing a separate solid cylinder known as a piston, which moves back and forth inside it. When the fuel ignites within each tube, it causes the gases within to heat up and expand. This forces the piston to drive forward, moving the connecting rod and turning the crankshaft, which in turn spins the propeller and drives the plane forward.

The 377's engines were actually quite unreliable, due to their complex, 28-cylinder composition. The plane was designed to be able to fly with only three working engines, but this did not save the plane from catastrophe. Between 1951 and 1970, Stratocruisers suffered 13 hull-loss accidents, with many fatalities. This is one of the reasons why the 377 was retired commercially in favour of jet aircraft.

THE GOLDEN AGE OF AIR TRAVEL

Commercial flights in the 1950s were still a luxury; only the wealthy were able to fly regularly for business and pleasure. In-flight freebies included cigars and evening robes – a far cry from the packet of peanuts you might receive on board today. Passengers often drank and smoke for the duration of the flight, reclining their seat and stretching their legs in the roomy cabin.

The food was comparable to a five-star hotel, and often consisted of a decadent three-course feast, served on china and glass rather than plastic and polystyrene. If you fancied getting some shut-eye, you were able to sleep in comfortable bunk beds made up in advance by the stewardesses. Modern day airlines would struggle to provide the luxury that 1950s passengers were accustomed to; it really was the golden age of air travel.

© Getty

LUXURIOUS LOUNGE
Beneath the main cabin was a lounge fitted with a bar, tables and plush seating.

SEATING
Cushioned reclining chairs came as standard, complete with a call button and an ashtray for smokers.

ENGINES
The plane's four 3,500hp piston engines provided the power required to take off and reach speeds of over 600km/h (373mph).

How long have tattoos been around?

Present day Permanent body art is now socially acceptable in most parts of the world; in the United States, roughly a quarter of people aged between 18 and 50 have tattoos, and this number is on the rise.

1891 Samuel O'Reilly patented the rotary tattoo machine. It was the first tattooing device to be powered by electricity, and many of its features are still present in the modern day version, which is used globally.

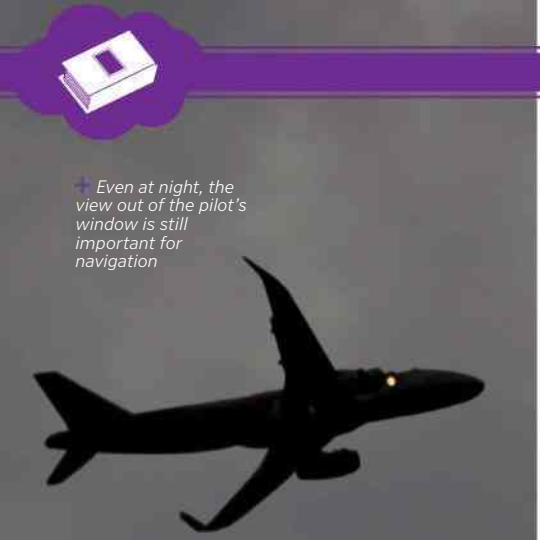
1769 Captain James Cook, the famous British explorer who completed the first circumnavigation of New Zealand, discovered Polynesian tattoos after sailing into Tahiti. He also learnt the island's word for their art form: tatau.

Circa 800 BCE - 500 CE Both the Greeks and the Romans used tattoos in order to identify slaves and criminals, as well as mercenaries, so that they could be found if they deserted. Tattoos may also have been used as a punishment.

Circa 3200 BCE Ötzi the Iceman was found preserved in the Alps in 1991, and bore the oldest examples of tattooing that have ever been discovered in Europe. He had a total of 61 carbon tattoos, mainly groups of straight lines.

Why are there seven days in a week?

A seven-day week first became 'official' by decree of the Roman Emperor Constantine in 321 BCE, but it had already been in use since ancient times, by the Sumerians and Babylonians. One theory is that the week was based on the seven visible celestial bodies from Earth: the Moon, the Sun, Mercury, Mars, Venus, Jupiter, and Saturn. It may also have to do with the length of time it takes for the Moon to pass through its phases.



Even at night, the view out of the pilot's window is still important for navigation

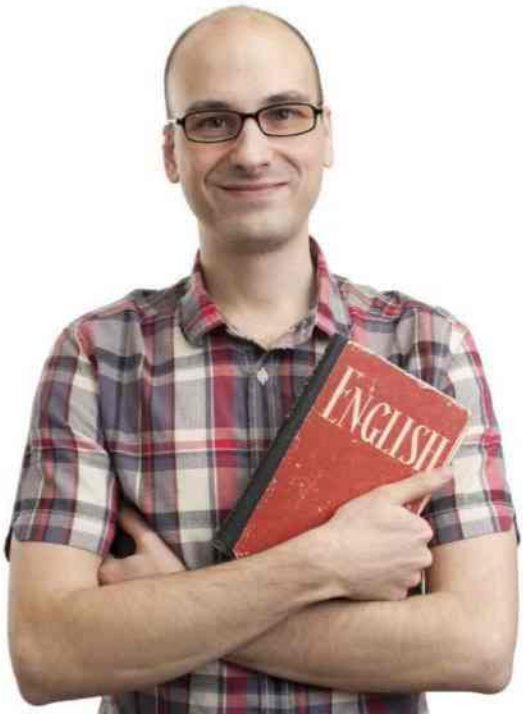
How did pilots navigate in the dark before GPS?

It was extremely difficult. The street lighting of towns and major roads would have provided some clues but during World War II, with blackouts over Europe, night bombers flew with a navigator who used the airspeed and compass bearing to plot a course on a map. Over water, some planes were fitted with a calibrated periscope sight that allowed them to measure their motion relative to wave crests and so compensate for a crosswind. Later 'LORAN' and 'Decca' radio stations were set up around the coast and planes could compare the timing of signals from different stations to triangulate their position.

What are the oldest words in English?

English borrows many words from the Romans and the ancient Greeks but these were only added to the English language in the middle ages.

The oldest words are for the most basic ideas. The word 'water' for example is essentially the same as the ancient Hittite word 'watar' or 'wadar' and probably dates back to 4000 BCE. But researchers at the University of Reading compared words across all the basic families of human language and found that only one had a common root in all of them. That word was 'thou' which is the singular form of 'you'.



What makes a medieval outlaw?

Outlaws in medieval England were literally criminals who were declared to be living outside the protection of the law. If a man accused of murder, for instance, failed to face his trial, the county sheriff would be tasked with finding him. The sheriff would then make appeals at several other courts, to give the fugitive a chance to hand himself in.

However, if he still evaded capture, the court would declare him an outlaw. The Latin term 'caput lupinum' ('wolf's head') was used at court to label the criminal as no better than an animal to be hunted.

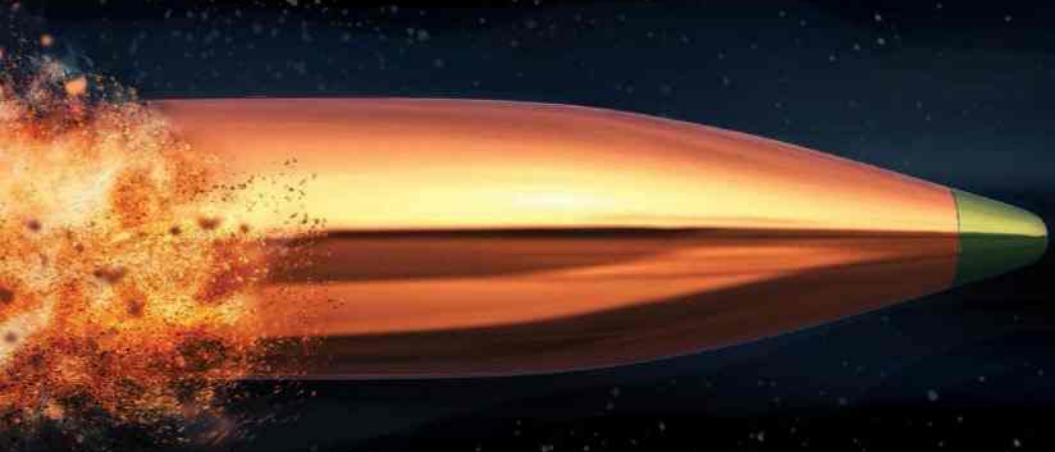
Only males over the age of 14 could be declared outlaws, and depending on the severity of their crime they could expect to lose all of their possessions, money, and any land they owned. As well as murderers; traitors, rebels or debtors could be declared outlaws if they failed to appear at court.

Anyone could steal from or even kill an outlaw and not face trial, as the outlaw was beyond the protection of the law. This meant that outlaw life could be incredibly harsh, and is why it was one of the most severe punishments of the time.

Space

With no air resistance, a bullet might travel through space forever

What would happen if you fired a gun in space?



The absence of air resistance and gravity would make a speeding bullet travel very differently in space. Although there would be no oxygen, bullets contain their own oxidiser, which would allow the gunpowder to ignite and fire the gun. With no air to slow it down, a bullet could in theory travel forever through deep space, although its path would be curved by the gravitational fields of large planets or other bodies. Floating freely in space, the recoil from the gun would also spin you in the opposite direction, a motion that would be harder to control without gravity holding you in place.

What are Cygnus, Pisces and Orion?

While we know that the stars are many light years away, and all at different distances, astronomers still put them into groupings called constellations. These are named after the characters, animals and objects they resemble – some of which are from the pages of mythology.

The constellations help us to make sense of the night sky. Without them, it would be a completely chaotic sprinkling of stars. We could still use celestial coordinate systems – which are similar methods to how we use latitude and longitude on Earth – to locate objects in the night sky, but constellations give astronomers a quick and highly visual way of getting their bearings in the vast expanse of the cosmos.

There are 88 official constellations (unofficial constellations, such as the Big Dipper, are called asterisms) and these provide the catalogue names of the stars. For example, Deneb is the brightest star in the constellation Cygnus, so this is known as Alpha Cygni. The brightest star in Boötes is Arcturus, so it is also called Alpha Boötis. The constellations also help us to locate deep sky objects. The Andromeda galaxy is in the constellation of Andromeda, so seasoned stargazers will know straight away the rough area of the sky in which to look.

ORIGINS OF CONSTELLATIONS

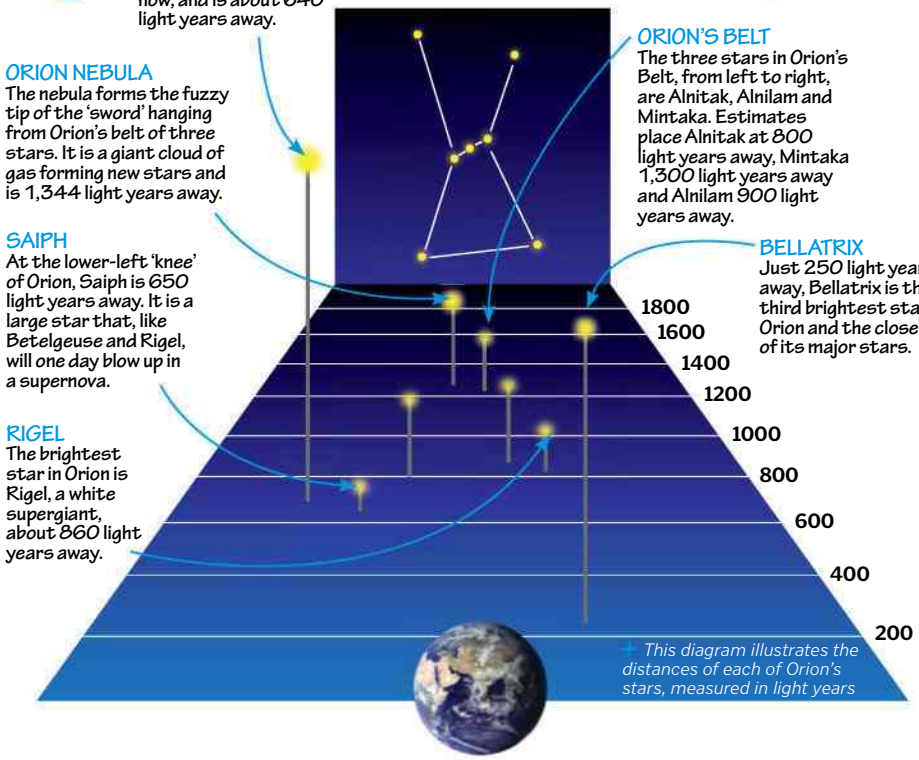
Civilisations going back to ancient times are thought to have charted the constellations. At first, these patterns of stars were used for astrological predictions and navigation, as well as for communication among astronomers. However, as the modern field of astronomy developed, it was soon discovered that different culturally nominated constellations made communication tricky. To solve the problem, the IAU divided the sky into 88 constellations between the Northern and Southern Hemisphere and gave them universally accepted names.

The entire sky is mapped by constellations – there's not one bit of celestial real estate that isn't included. The modern constellation borders were drawn up in 1930 by the International Astronomical Union (IAU), and extend beyond the traditional star patterns to include the space around them.

You'll probably have heard of the Zodiac constellations – Capricorn, Aquarius, Pisces and so on. They are plotted along the path that the Sun appears to move through each year. As you'd expect, your sign is the constellation that the Sun was in at the time of your birth.

DISTANCES TO THE STARS OF ORION

Orion might look flat, but its stars are spread over hundreds of light years



This diagram illustrates the distances of each of Orion's stars, measured in light years

Why is there a planet with a tail?

Some exoplanets are just bizarre, and none more so than Gliese 436b. It's what astronomers call a hot-Neptune – a Neptune-sized world that is extremely close to its star and therefore is very hot. What makes Gliese 436b – which is about 33 light years away – even weirder is its tail, which resembles that of a comet.

The planet has a thick gaseous hydrogen atmosphere, but since it orbits a mere 4 million kilometres (2.5 million miles) away from its parent star, this atmosphere is evaporating due to stellar radiation. The resulting cloud of dispersed hydrogen creates a huge comet-like tail that trails behind the exoplanet as it speeds around the star, completing an entire orbit in just 2.6 Earth days. Scientists estimate that Gliese 436b has lost as much as ten per cent of its atmosphere during its lifetime. It also shed hydrogen at a much greater rate in the past, while its star was more active.

HOW A PLANET CAN SPROUT A TAIL

The process behind this strange phenomenon

1 MOVING IN CLOSER
Hot-Neptunes like Gliese 436b probably don't start out close to their stars, but migrate inwards early in their lives. At first, their atmospheres are a mix of hydrogen and helium, with water and methane too.

An artist's impression of the huge trail of water vapour streaming away from Gliese 436b

2 A SWOLLEN ATMOSPHERE

Having migrated in so close to their stars that they complete orbits in just a few hours or days, hot-Neptunes begin to heat up, causing their atmospheres to expand and the water to evaporate.

3 BLOWN AWAY

Hydrogen is a light gas and over billions of years is stripped away from the atmosphere, creating a tail of gas trailing in its wake. As the hydrogen is boiled away the planet is left with a helium-dominated atmosphere.

©NASA;ESA

POOL-SIZED SPACE ENVIRONMENT

In the Neutral Buoyancy Laboratory, astronauts can get a taster of what working in space will feel like

VOLUMINOUS
The pool contains an enormous amount of water: 28 million litres (6.2 million gallons) – the same as ten Olympic swimming pools!

How do astronauts train for zero gravity?

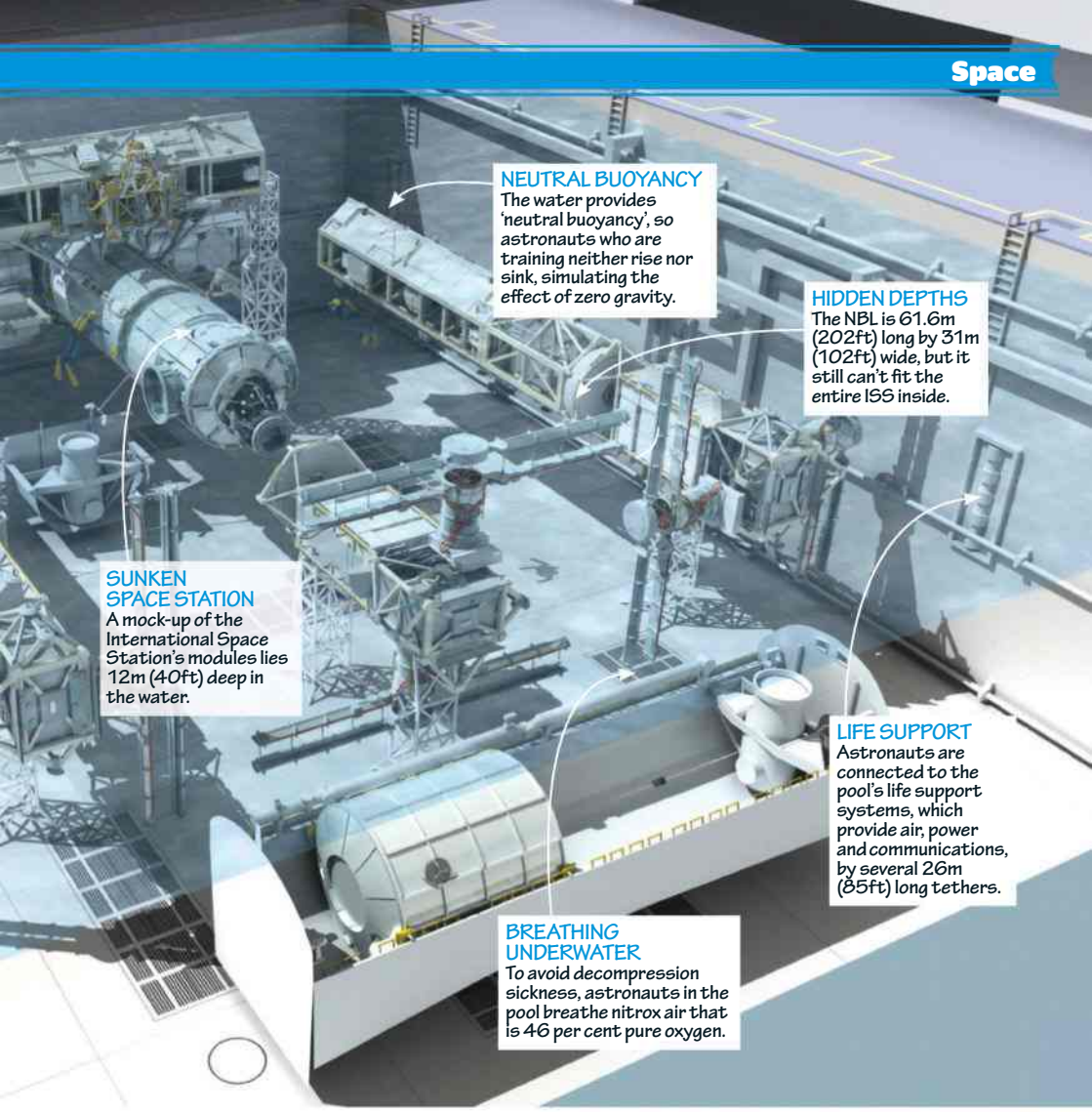
SAFETY
In 115,000 hours of dives, there has never been an accident with an astronaut. They are supported by a team of safety divers and cameramen.

When an astronaut prepares for a mission to the International Space Station, they must practise the tasks that they'll be carrying out in space. However, in order to make the training as realistic as possible, the microgravity they'll encounter outside our planet's atmosphere needs to be mimicked down here on Earth.

It may sound far-fetched, but NASA has an ingenious way of replicating space's unique environment on our home planet – it has placed a large-scale mock-up of the International Space Station in an enormous swimming pool. The American space agency calls this 12-metre (40-foot) deep pool the Neutral Buoyancy Lab (NBL) and astronauts have been training here since 1996.

Astronauts undertake six-to-eight-hour underwater sessions on a daily basis – the equivalent time for an Extravehicular Activity session when they're up in space. When it's time to begin the training, a camera diver shadows the astronaut to capture everything that happens, so that the footage can be reviewed later. Safety divers are also on-hand at all times in case of an emergency and the astronaut is rigged up to various support systems for air, power and communications.

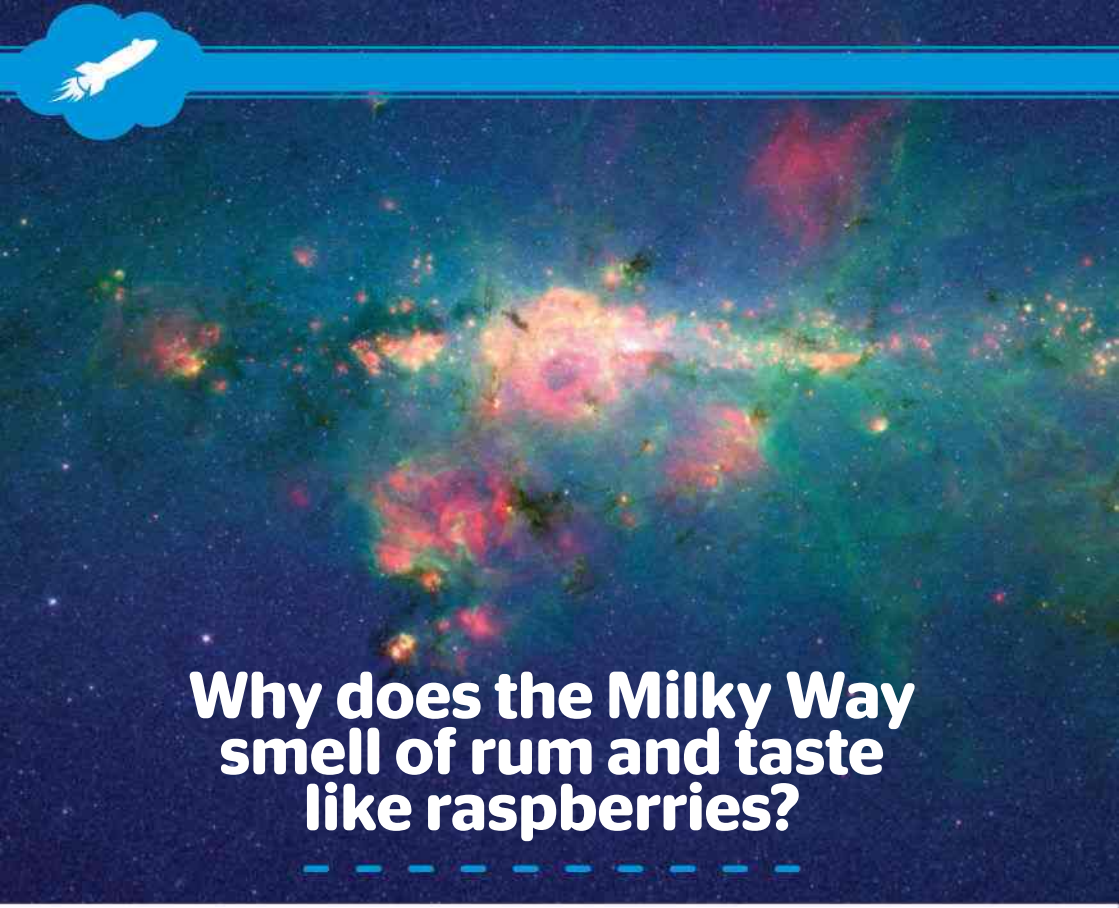
Underwater, the trainee astronaut is breathing nitrox air, which is comprised of 46 per cent oxygen rather than the normal 21 per cent we breathe every day. This increased oxygen concentration works to reduce the risk of decompression sickness. Long tethers also enable an astronaut to lock themselves onto handrails while they are practising a task. Everything they do underwater is a simulation of what they'll be doing when they eventually board the International Space Station.



SIZE DOES MATTER

Before getting in the water for a session in the Neutral Buoyancy Laboratory, an astronaut has to dress for the part. During the fitting for their space suit, there are 36 measurements taken of their bodies and 46 measurements of their hands, while plenty of padding inside the suit ensures they don't slip around. The end result is so heavy – weighing almost as much as two men – that several technicians are required to help the astronaut get suited and booted.

European Space Agency astronaut Samantha Cristoforetti, flight engineer of Expedition 42/43, prepares to be submerged in the waters of the NBL



Why does the Milky Way smell of rum and taste like raspberries?

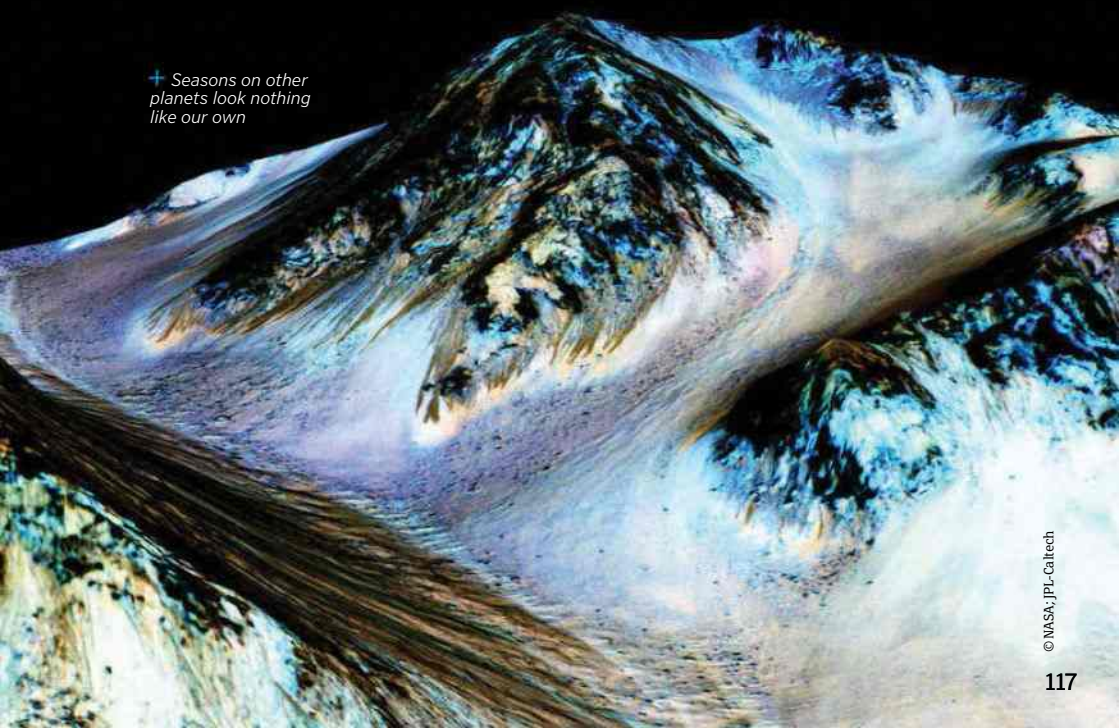
This unlikely discovery was made completely coincidentally by astronomers studying interstellar objects for new molecules. They had the IRAM radio telescope trained on Sagittarius B2 – a gas cloud at the centre of the Milky Way galaxy – when they found a chemical called ethyl formate. This is one of the aroma compounds that helps to create the sweet scents of fruit, wine and flowers, and when isolated it smells a lot like rum. It is also the chemical that gives raspberries their distinctive flavour.

Ethyl formate is made from ethanol – a common molecule found in star-forming gas clouds – with formic acid, which is a mix of hydrogen, oxygen and carbon atoms. It's visible to radio telescopes because ethyl formate molecules absorb the radiation from the surrounding stars and re-radiate it at radio wavelengths. Ethyl formate molecules are some of the largest individual molecules ever found in space and are also among the building blocks of amino acids, which are vital for life as we know it on Earth.

Even though Sagittarius B2 is extremely dense as far as star-forming regions go, however, it still only has around 3,000 molecules per cubic centimetre, compared to around 25 million trillion molecules per cubic centimetre in the air that we breathe on Earth. So, even if you could breath and sniff in the nebula, it would sadly be too rarefied to actually smell the rum or taste the raspberries.

Do other planets have seasons like Earth?

Other planets experience seasons, although these typically look nothing like our planet's. Our seasons are caused by the 23-degree tilt in Earth's axis of rotation, exposing its hemispheres to different amounts of sunlight. Planets with a very slight tilt, such as Jupiter, have very small variations across the year. At the other extreme, with an 82-degree tilt, Uranus's hemispheres lean away from the Sun for decades at a time before swapping over. When spring comes after each 20-year winter, huge storms are triggered in its atmosphere. Other planets also experience differences due to the size and shape of their orbits (orbital eccentricity). A shorter orbit, such as Venus's, results in a much shorter year and shorter seasons. Unlike Earth, which has an almost circular orbit, Mars is ten per cent closer to the Sun during its northern hemisphere's winter than summer, giving rise to differences in the seasons undergone by either hemisphere.



Seasons on other planets look nothing like our own

What colour is the sky on Pluto?

Pluto in silhouette as seen by New Horizons, with sunlight from behind the dwarf planet shining through the atmosphere

An azure blue halo around Pluto is the signature that this dwarf planet has an atmosphere, and that there are chemical reactions occurring there, too. We know that Pluto's atmosphere contains nitrogen and methane, but these would not turn the sky blue. When NASA's New Horizons space probe flew past Pluto on 14 July 2015, some of the amazing pictures that it took showed layers of atmospheric haze above the dwarf planet's surface. Pluto's atmosphere is not like Earth's; you couldn't breathe it and it is much less dense – the surface pressure on Pluto is three millionths of a bar, compared to Earth's one bar.

So why does it appear blue? New Horizons is showing us layers of haze around Pluto, full of nitrogen and methane molecules. Even though the Sun is far away, its ultraviolet light can break down these molecules, instigating chemical reactions that produce tholins, which are small, soot-like particles. These slowly sink to Pluto's surface and absorb red light, but scatter blue light, so we see Pluto's atmosphere as blue.

Where are spacecraft built?

You can head to the nearest operating theatre or clean your kitchen from top to bottom, but you'll never find anywhere that is quite as squeaky clean as the quarters where spacecraft are built. Not too surprisingly, these assembly areas are known as cleanrooms.

Think of your favourite spacecraft – whether it's the Cassini probe which travelled to Saturn or the Rosetta mission that swung into orbit around Comet 67P, you'll find that it was assembled in a cleanroom before it was launched. The reason for this is that even the tiniest speck of dirt could cause an electrical circuit to fail or, if dust settles on a spacecraft's mirrors or lenses, then the spacecraft could 'go blind'. The water content in the air is also kept fairly low by maintaining temperatures at around 20 degrees Celsius (68 degrees Fahrenheit).

For cleanrooms to remain contaminant-free, the air must be filtered and everyone entering the area must walk across a sticky floor mat to remove any dirt from their shoes. They must also wear a sterile 'bunny suit' that fits snugly around their head and feet, as well as gloves and a face mask.

Engineers must wear 'bunny suits' when they are working on a satellite

An artist's impression of a quasar hidden away inside a doughnut-shaped cloud of dust and gas that contains vast amounts of water

Is there an ocean floating in space?

In a distant galaxy 12 billion light years away is a huge volume of water vapour, totalling 140 trillion times more than all the water in Earth's oceans. The discovery of this water was made by scientists from NASA's Jet Propulsion Laboratory who used radio telescopes to identify the signature of water molecules in the light of the quasar named APM 08279+5255.

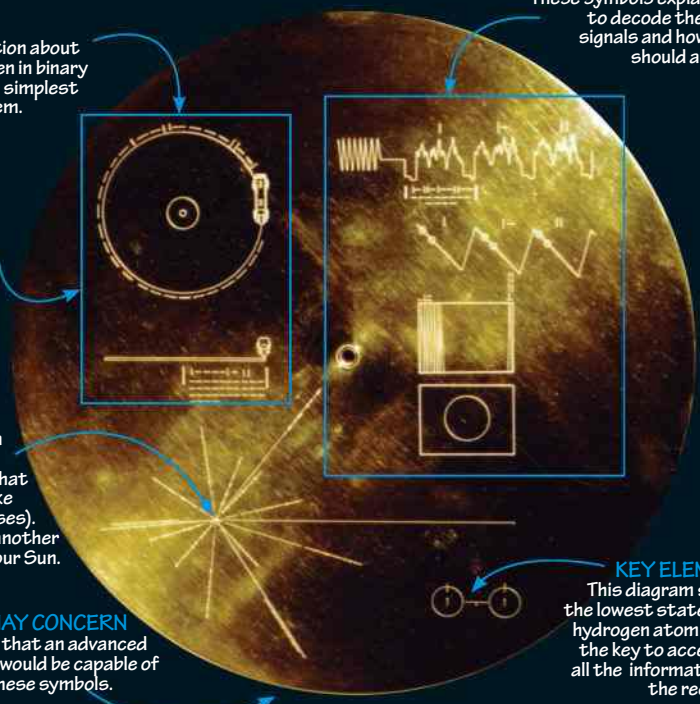
A quasar is an active galaxy powered by a supermassive black hole at its centre that is firing a jet of radiation almost directly at us. The quasar produces a thousand trillion times more energy than the Sun, and APM 08279+5255 in particular contains an estimated 4,000 times more water than the entire Milky Way galaxy. The water was found within a gaseous region hundreds of light years across that surrounds the galactic centre, and will possibly end up being swallowed by the black hole, giving it a truly monumental drenching.

What's on board the Voyager probe?

The Voyager spacecraft – launched in 1977 and still going strong – are headed into deep space now that they have completed their tour of the planets. On the off-chance that they may be found by aliens, or even humans in the future, each Voyager spacecraft carries onboard a golden phonographic record, devised by famous astronomer Carl Sagan. The record plays natural sounds, music, images and greetings from Earth in 55 languages, while its cover contains technical information describing the world that the Voyager spacecraft have come from, and how to play the messages for any aliens who are unfamiliar with record players.

MESSAGES TO OUTER SPACE

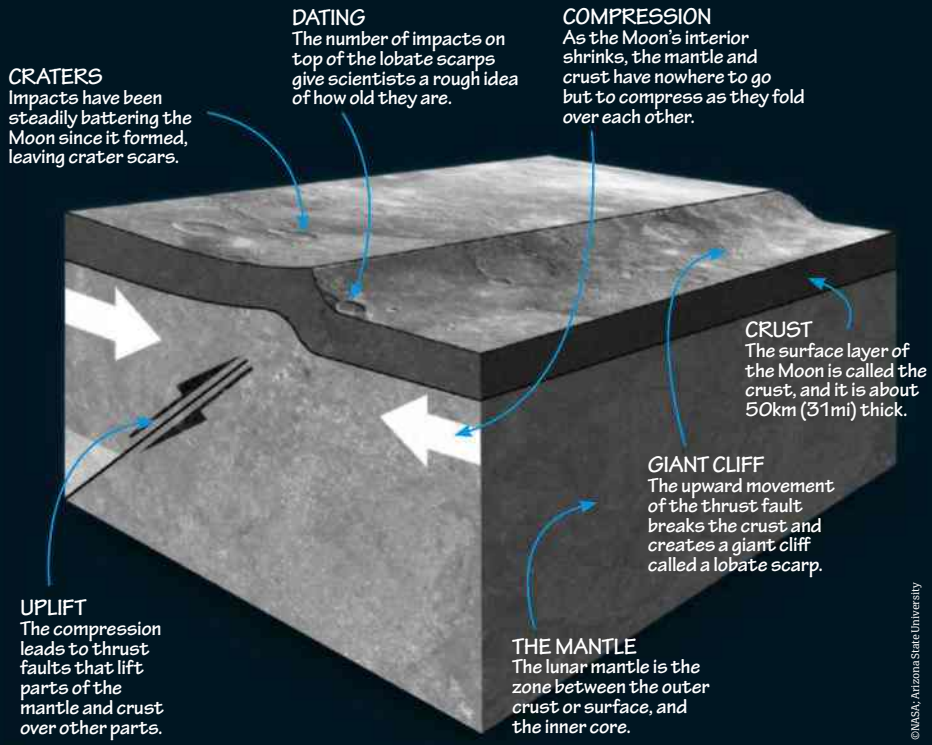
The Voyager Golden Records use maths and astronomy to communicate

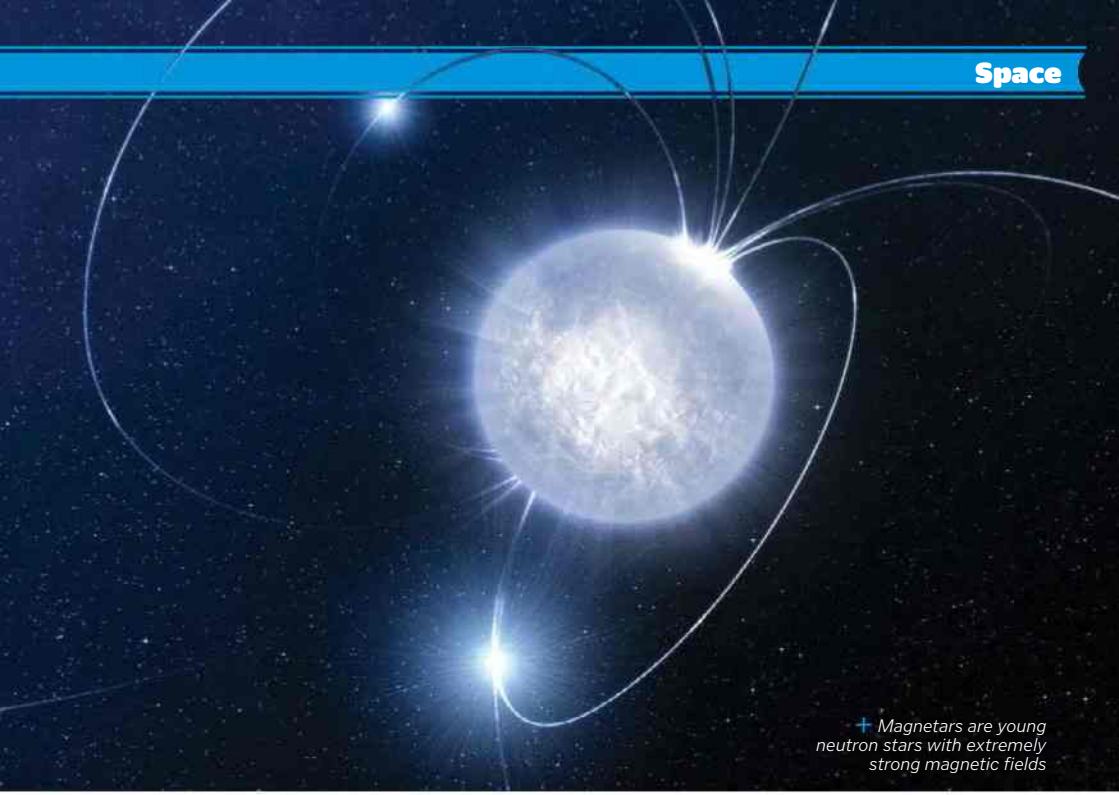


Why is the Moon shrinking?

Our Moon didn't have an easy start in life. It was likely formed in the furnace of a massive collision between Earth and a protoplanet, and has since suffered a multitude of asteroid strikes. These impacts, together with the decay of radioactive elements on the Moon, generated heat. Over millions of years our lunar companion has cooled and, as a result, shrunk. Like an apple that goes bad, its surface has wrinkled, folded and broken. NASA's Lunar Reconnaissance Orbiter has imaged giant cliffs on the lunar surface called lobate scarps, which formed when the Moon's interior contracted as it cooled and the surface, like loose skin, wrinkled. Based on the size of the biggest scarps, which formed sometime in the last billion years, the Moon's radius has shrunk by about 91 metres (300 feet).

HOW THE SCARPS FORM





Magnetars are young neutron stars with extremely strong magnetic fields

How much does a teaspoon of neutron star weigh?

Everything about neutron stars is extreme. They pack up to twice the mass of the Sun into their tiny volumes and are incredibly magnetic. The most magnetic examples are called magnetars and if one were in orbit around Earth like the Moon, its magnetic field would be able to wipe every credit card on the planet. Stand on their surface and you would feel gravity 200 billion times stronger than on Earth. If the neutron star is spinning, it will fire beams of energy from its rotational axis as particles are accelerated near its magnetic poles – if we are in the line of sight of these rotating beams, we see them pulse as a pulsar.

Neutron stars are created when giant stars die in supernovas. Fusion ceases and the star collapses in on itself, compressing the core. A shock wave rebounds off the core and obliterates the star in a supernova, leaving behind the squashed core that has become so dense that it is only 11.3 kilometres (seven miles) across and electron and proton particles have been compressed together to create an object made entirely of neutron particles. A teaspoon of this would weigh ten billion tons.

What is floating around in our Solar System?

When the planets formed 4.5 billion years ago, they grew from rocky and icy material that had condensed out of a disc of gas that surrounded the Sun. This process was messy and left the Solar System filled with rubble that comes in a range of sizes, from tiny specks of dust to half-finished proto-planets and mountains of ice that hurtle towards the Sun from the frozen depths of space. Today, we know this debris as comets, asteroids, and dwarf planets. Many of them have been relatively untouched since they formed and, by studying their chemistry and composition, scientists

THE WORLD OF SPACE DEBRIS

The Solar System is filled with all kinds of litter left over from the birth of the planets

ASTEROID COLLISIONS

The Asteroid Belt is actually fairly empty, but sometimes asteroids do collide. Their surfaces are scarred with craters and smaller chunks are blasted off them by the impacts.

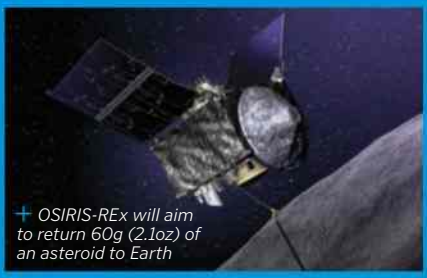
ASTEROID BELT

The Asteroid Belt between Mars and Jupiter contains millions of asteroids. Most are tiny, while around 200 are larger than 100km (62mi) wide.

BRINGING SPACE ROCKS TO EARTH

In 2016, NASA will launch one of its most ambitious missions yet, called OSIRIS-REx. Its name is an acronym for the more long-winded Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer. The plan is to send it to an asteroid known as 101955 Bennu, where it will attempt to capture a 60-gram (2.1-ounce) sample of the asteroid using its Touch-And-Go Sample Acquisition Mechanism, or TAGSAM for short.

OSIRIS-REx will approach the asteroid until it gently touches its surface (the asteroid is too small to have enough gravity for the spacecraft to 'land'). Then it will fire jets of nitrogen gas to 'fluidise' the dirt on the surface (the technical name for this dirt is 'regolith'), allowing the capture device to scoop up a sample and store it in a capsule. When OSIRIS-REx heads back to Earth in 2023, the capsule will be ejected and will parachute back down to Earth, to be retrieved by scientists who will study the pristine sample in laboratories.



OSIRIS-REx will aim to return 60g (2.1oz) of an asteroid to Earth

COMET
The icy equivalent of an asteroid is a comet. They come from the outer Solar System and flare up, growing tails of gas and dust as they get near the Sun.

EXTINCT COMET
The inner Solar System is littered with extinct cometary nuclei, which have lost all their ice and gases and can no longer form tails.

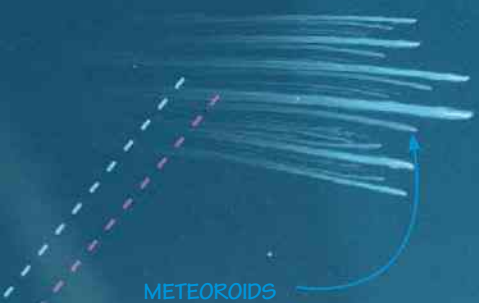
PROTO-PLANET
The dwarf planet Ceres and the second largest asteroid, 500km (311mi) wide Vesta, are thought to be leftover proto-planets that for some reason, never grew into full-size planets.

can learn a great deal from them about the conditions in the Solar System when the planets, including Earth, were being built.

The plane of the Solar System, known as the ecliptic, is filled with a fine haze of dust. Sometimes we can see this dust reflecting sunlight and appearing as a faint glow called the zodiacal light. Some of this dust comes from the grinding down of larger rocky bodies through collisions. These larger bodies are asteroids. Although most reside in the Asteroid Belt between the planets Mars and Jupiter, there remain many that move among the planets. The largest asteroid is Ceres and it is so big that it has been given the title of dwarf planet, the same label that is given to Pluto. Scientists think it is a proto-planet that was never able to fully form.

When asteroids collide, they send smaller pieces spinning into space. These smaller chunks of rock are called meteoroids. Sometimes these find their way to Earth and fall through the atmosphere, and we see them as meteors. If they don't burn up on entry and instead reach the ground, we call them meteorites.

Comets come from further afield, in the outer Solar System where it is colder and there is more ice. Most comets originate in either the Kuiper Belt beyond Neptune, or the even more distant Oort Cloud.

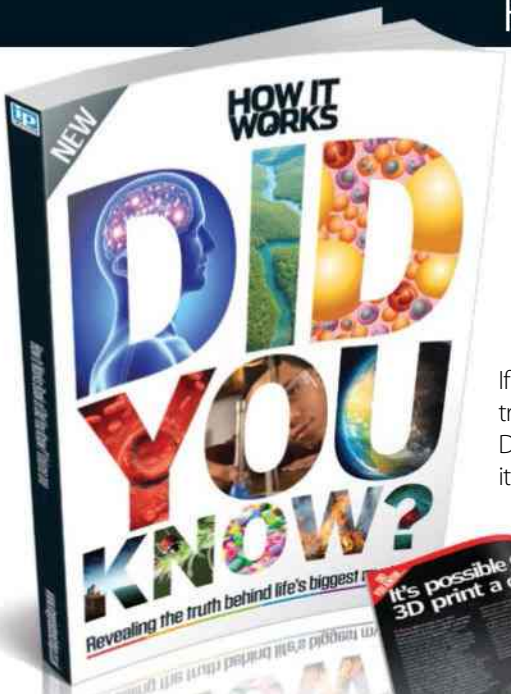


METEOROIDS

When collisions between asteroids send smaller chunks flying through space, we call these small pieces meteoroids. Sometimes comets can leave small meteoroids behind in their tails.

The surface of Vesta, photographed by NASA's Dawn spacecraft; Vesta is the second largest object in the Asteroid Belt

From the makers of HOW IT WORKS



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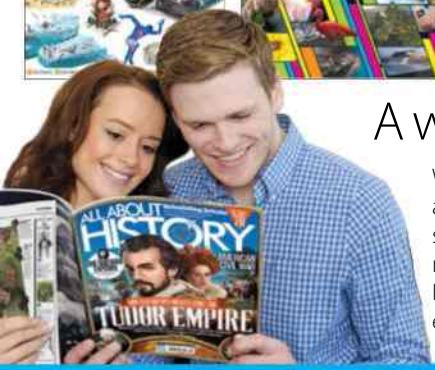

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